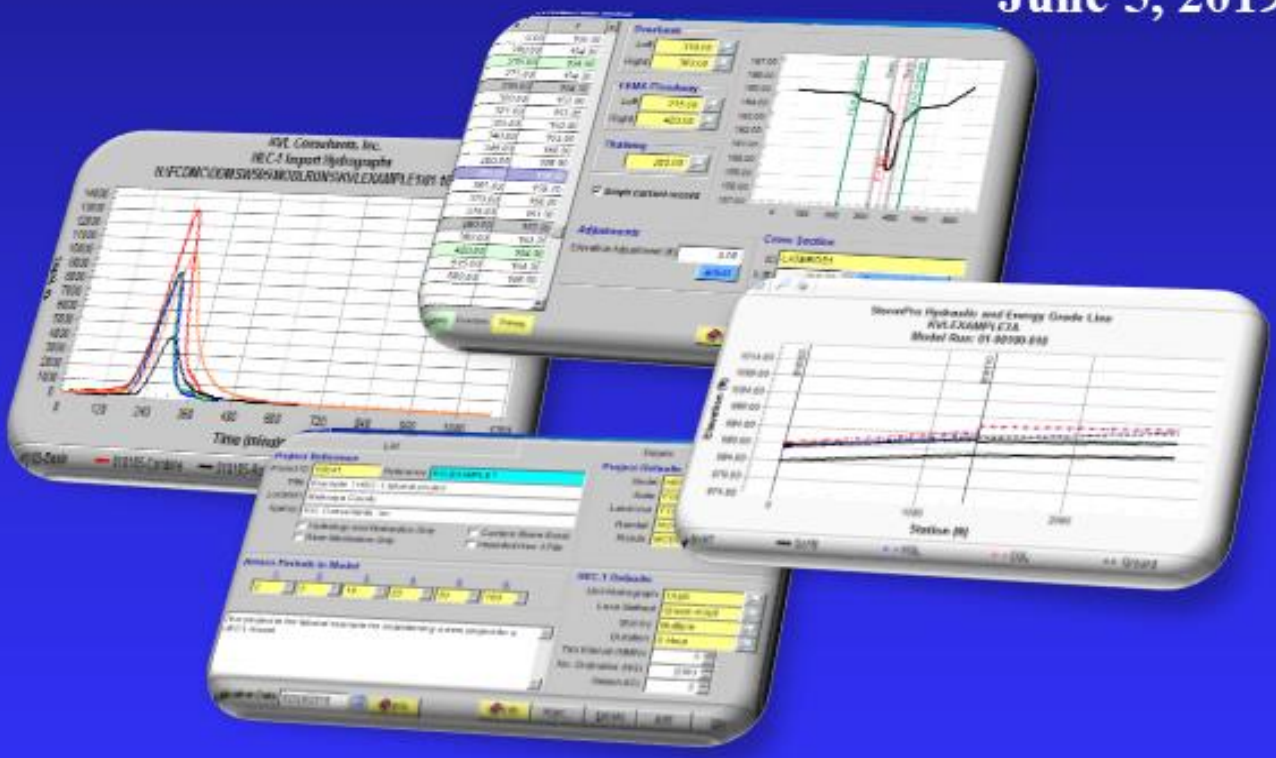
The Flood Control District of Maricopa County

DDMSW Training Workshops

RIVER MECHANICS

June 5, 2019



Maricopa County Department of Transportation (MCDOT)
Computer Training Room
2919 W Durango St, Phoenix, Arizona 85009

Presented by:

Kenneth Lewis, P.E.
KVL Consultants, Inc.

DDMSW Training Workshops

River Mechanics

Training Dates: June 5, 2019 (Wednesday)
June 12, 2019 (Wednesday)

Location: Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Instructor: Kenneth V. Lewis, P.E.
DDMSW Developer

This training class is designed for hydraulic and hydrologic engineers interested in learning DDMSW, an application program that implements District's River Mechanics and Drainage Design Methodologies and Standards

Agenda

8:30	**–**	**9:00**	**Application Overview**
			System Overview, Program Installation, General Features, Files, Tools, Administration, Help, New Features
9:00	**–**	**10:30**	**River Mechanics Overview**
10:30	**–**	**10:45**	**Morning Break**
10:45	**–**	**12:00**	**River Mechanics Examples**
			Scour, Riprap Sizing, Launchable Riprap, Lateral Erosion, Sediment Yield
12:00	**–**	**1:00**	**Lunch Break**
1:00	**–**	**2:00**	**Scour Analysis Tutorial**
2:00	**–**	**2:45**	**Riprap Sizing and Launchable Riprap Tutorial**
2:45	**–**	**3:00**	**Afternoon Break**
3:00	**–**	**3:30**	**Lateral Erosion Tutorial**
3:30	**–**	**4:00**	**Sediment Yield Tutorial**

DDMSW 5.6.0
TRAINING WORKSHOPS

RIVER MECHANICS

Engineering Application Development and River Mechanics Branch
Engineering Division
Flood Control District of Maricopa County

June 2019

This document contains step-by-step tutorials for the River Mechanics module of DDMSW. The tutorials for the River Mechanics cover the computations of total scour for bank protection, riprap sizing for banks and bed protection, launchable riprap for banks, lateral erosion from FEMA floodways and sediment yield analysis for storage basins.

TABLE OF CONTENTS

II RIVER MECHANICS

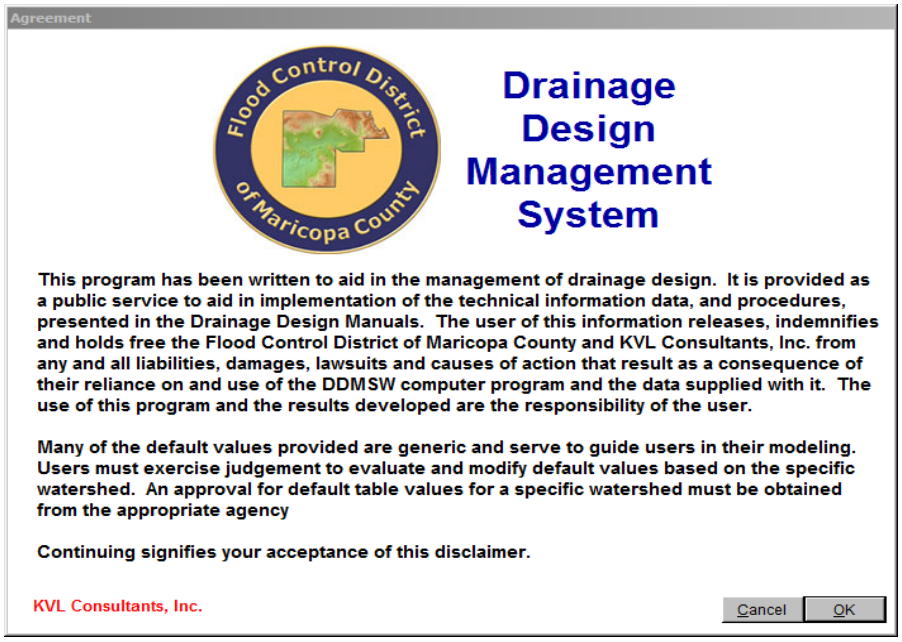
2.1 Total Scour for Bank Protection

To estimate the total scour depth for a channel bank protection project involving a mild or a moderate bend, use *"Equilibrium Slope for Sediment-Laden Flow"* method for long-term scour, and "*Lacey"* method for general scour (which includes the evaluation of bend scour).

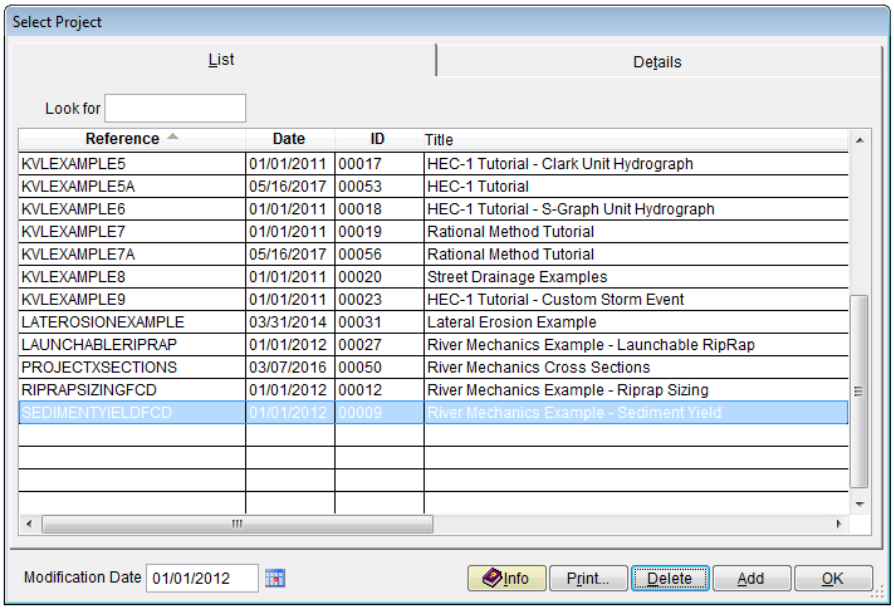
1. Establish a New Project and Default Set-up
2. Prepare the Cross Section Hydraulics
3. Compute Total Scour
    A. Set up Total Scour Basic Data
    B. Calculate the Long Term Scour
    C. Calculate the General Scour
    D. Calculate the Bedform Scour
    E. Calculate the Low Flow Scour
    F. Calculate the Total Scour
4. Report and Documentation of Results

2.1.1 Establish a New Project and Defaults Set-up (Step 1)

(a) Click the **DDMSW** icon on the Desktop or Program menu to launch the **DDMSW** software. Click **OK** to accept the software disclaimer as is shown in the following figure.



After the **DDMSW** software is launched, the **SELECT PROJECT** window is automatically opened as is shown in the following figure.



(b) Click the **Add** button on the **SELECT PROJECT** window to start a new project (Or **File** ➔ **New Project** ➔ **Add**).

(c) On the **NEW PROJECT OPTIONS** form, select **River Mechanics** checkbox and click the **OK** button to close the form.

(d) Type "SCOURTUTORIAL" into the **Reference** textbox. This is the name of this newly created project. The users can choose any name as long as it does not exist in the **DDMSW** project database.

(e) Type into the **Title** textbox a brief descriptive title of this project ***(Optional)***.

(f) Type into the **Location** textbox the location of this project ***(Optional).***

(g) Type into the **Agency** textbox the agency or company name ***(Optional).***

(h) Check **River Mechanics Only** checkbox for this project.

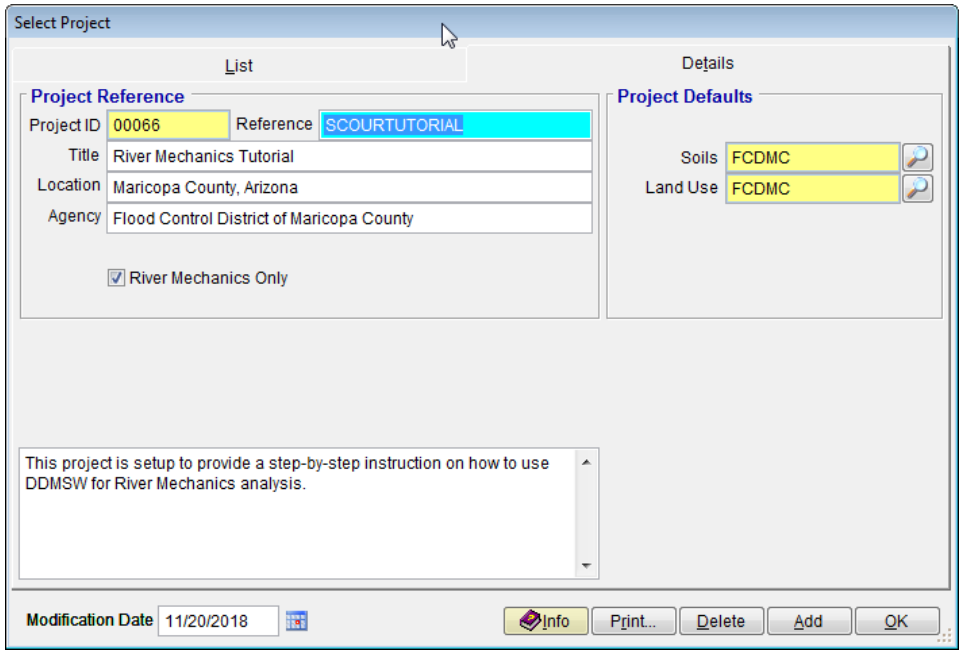
(i) Type a detailed description of this project into the comment area under the **Project Reference** frame ***(Optional).***

(j) Set the **Modification Date** using today's date by clicking on the Calendar icon.

(k) Click the **Save** button to save the entered data.

(l) Click the **OK** button on the **SELECT PROJECT** window to close the window, the following figure shows what the window looks like.

(m) Click the **OK** button on the pop-up message box.



Note: The **Project ID***"00066"* in the above figure is the unique read-only identifier of the project in the DDMSW Project Database, which is automatically generated by the program when a new project is created. When users create a new project, the **Project ID** of the new project will not be the same as the **Project ID** shown in the above figure.

2.1.2 Prepare the Cross Section Hydraulics (Step 2)

(a) From the menu bar of the main application window, click **River Mechanics➔Cross Section Hydraulics** to open the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** window.

(b) Click the **Add** button to add a record.

(c) Select the *"Calculate Data"* for the **Source** *("Enter Data"* can also be selected for the **Source** if the hydraulic results for a cross-section are available.)

(d) Type "*STUDYREACHCROSSSECTION*" into the **Section ID** textbox

(e) By default, both the **Design** and **Dominant** textboxes in the **Entire Cross Section** frame are checked. If not, please check these two checkboxes.

(f) Check the **Total Scour** check box (if not yet checked).

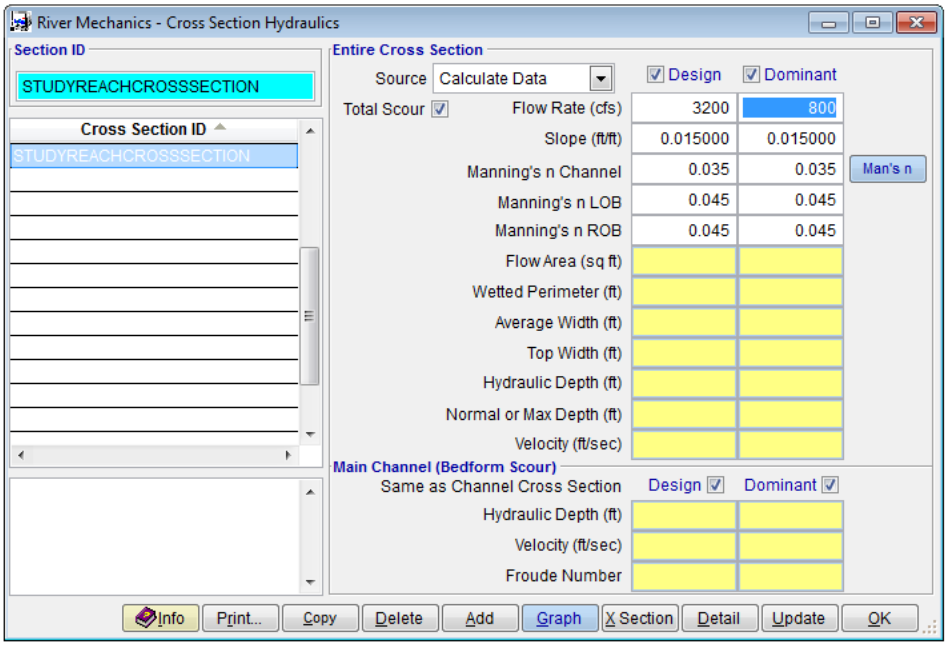
(g) Type in "*3200*" and "*800*" into the **Flow Rate (cfs)** textboxes for **Design** and **Dominant**, respectively

(h) Type in "*0.015*" and "*0.015*" into the **Slope (ft/ft)** textboxes for **Design** and **Dominant**, respectively

(i) Type in "*0.035*" and "*0.035*" into the **Manning's n Channel** textboxes for **Design** and **Dominant,** respectively. Type in "*0.045*" and "*0.045*" for the **Manning's n LOB** and **Manning's n ROB** textboxes.

(j) Check **Same as Channel Cross Section** checkboxes for both the **Design** and **Dominant** in the **Main Channel (Bedform Scour)** frame. (Note: These boxes are checked if the bedform scour computation is based on the Channel cross-section hydraulics).

(k) After the data entry, click the **Save** button. The form should look like the following figure.



(l) Click the **OK** button to close the window.

(m) From the menu bar of the main application window, click **River Mechanics➔ Cross Section Geometry** to open the **NATURAL CROSS SECTIONS** form.

(n) Click the "Magnifying Glass" on the right side of the **ID** textbox in the **Cross Section** frame to open the **SELECT CROSS SECTION ID** form. Highlight **Cross Section ID** "*STUDYREACHCROSSSECTION*" and click **OK** to close the form.

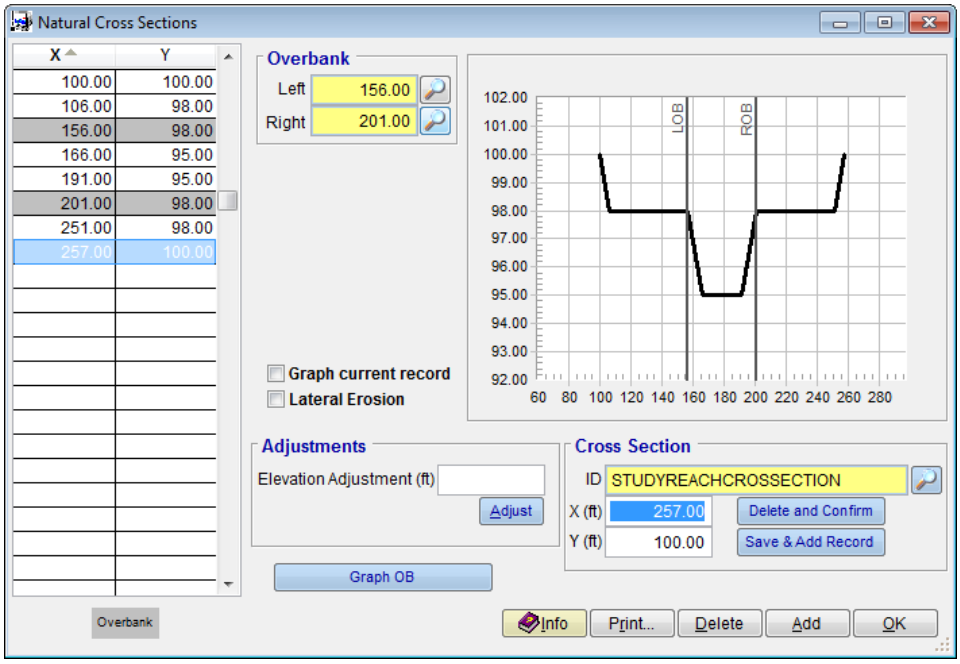
(o) Click the **Add** button on the **NATURAL CROSS SECTIONS** form and type "*100*" and "*100*" into the **X (ft)** and **Y (ft)** textboxes, respectively. Click the **Save & Add Record** button. For the last record, just Click **Save.**

(p) Repeat the above step (o) for the rest of pairs of **X** and **Y** values provided below.

Station (X)	Elevation (Y)	Notes
106	*98*	
156	*98*	*Left Bank Station*
166	*95*	
191	*95*	
201	*98*	*Right Bank Station*
251	*98*	
257	*100*	

(q) To define the LOB, highlight the X value = 156 and Click the button adjacent to the Left Overbank. To define the ROB, highlight the X value = 201 and Click the button adjacent to the Right Overbank.

After all the **X** and **Y** values and LOB and ROB are entered, the **NATURAL CROSS SECTIONS** form should look like the following figure.

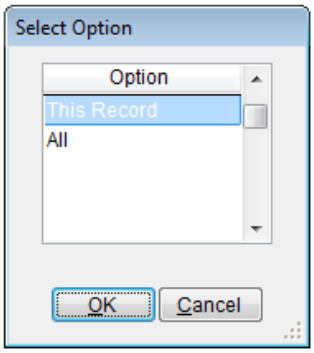


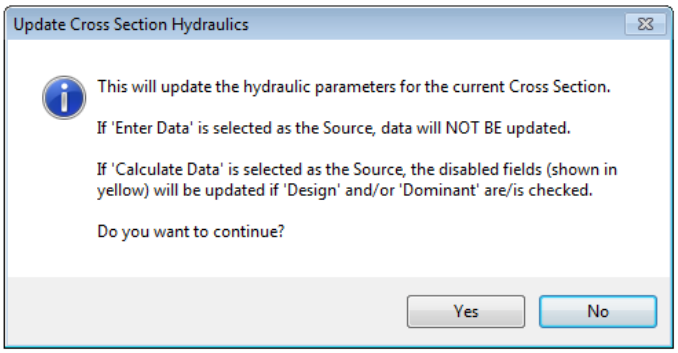
Cross-section data can be imported into **DDMSW**. However, the X-Y data must be prepared based on **DDMSW** X-Y data format before the cross-section is imported. To know the **DDMSW** X-Y data format, export the data of an existing cross-section (**File ➔ Export Data ➔***select "Cross Sections" under "Hydraulics"* **Section** on the **SELECT A TABLE TO EXPORT** form. Click the **Export** button and on the **SELECT FIELDS TO EXPORT** form, select "*XLS" as the* **Export Type***.* Click **Save** to save the setting, and click **Export.** On the **SAVE AS** form, navigate to where you want to save the exported file and click the **Save** button. Finally, click **OK.** Once the file is created, the format can be examined. The format could be used as template for creating importable *.XLS files for DDMSW).

(r) Click **OK** to close the **NATURAL CROSS SECTIONS** form.

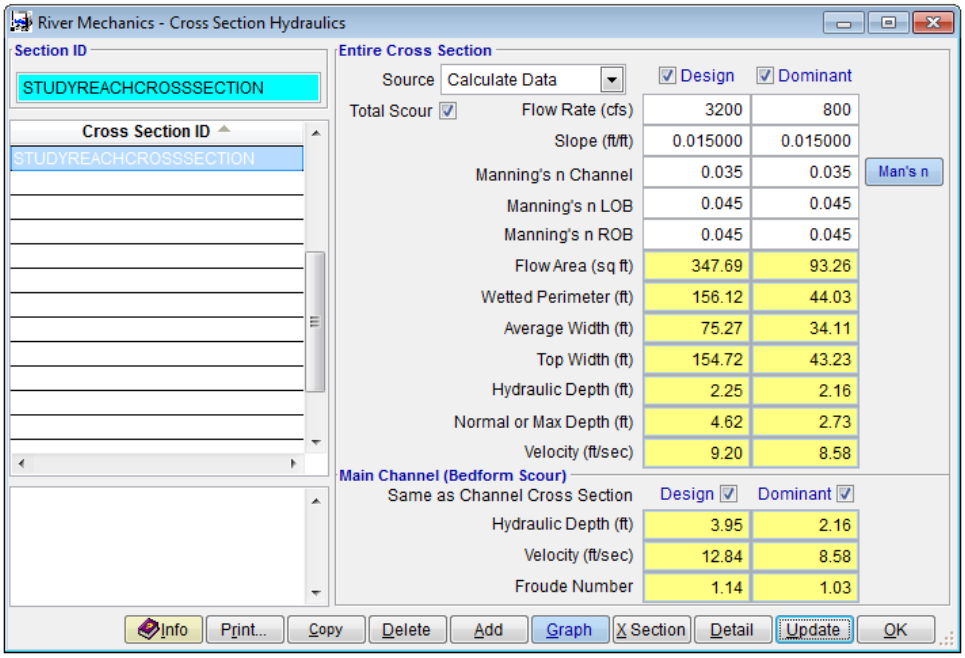
(s) Go back to the main application window, and click **River Mechanics➔ Cross Section Hydraulics** from the menu bar to open the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form. Click the **Update** button to update the hydraulic parameter listed on the form by performing a hydraulic analysis using the geometric data provided. The textboxes with yellow highlights will be populated with results from the analysis.

(t) Highlight "*This Record"* and click the **OK** button to close the **SELECT OPTION** form. Click **Yes** on the **UPDATE CROSS SECTION HYDRAULICS** form to continue.





After the update, the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form should look like the following figure.



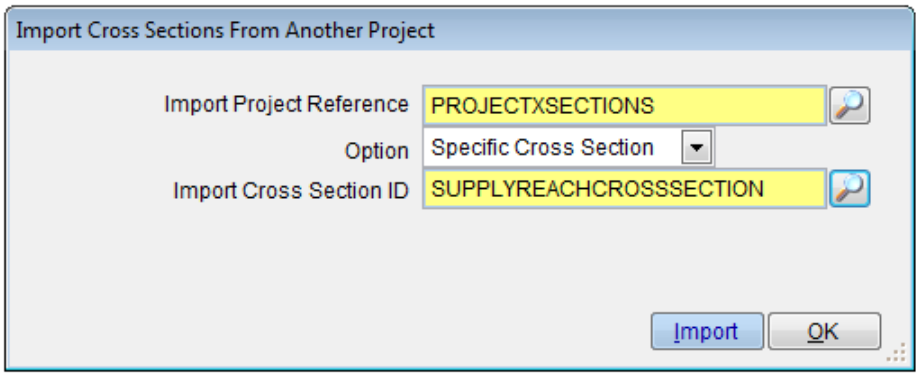
To create the supply reach cross section data for the project, the user can manually enter the dataset using the same procedure [i.e., **Section 2.1.2**, from (a) to (r)]. In this tutorial, since the data have already been created in another project, the *"SUPPLYREACHCROSSSECTION"* dataset will be imported.

(u) To import all cross sections that will be used in this tutorial, open the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form **(River Mechanics ➔ Import Cross Sections from Another Project**).

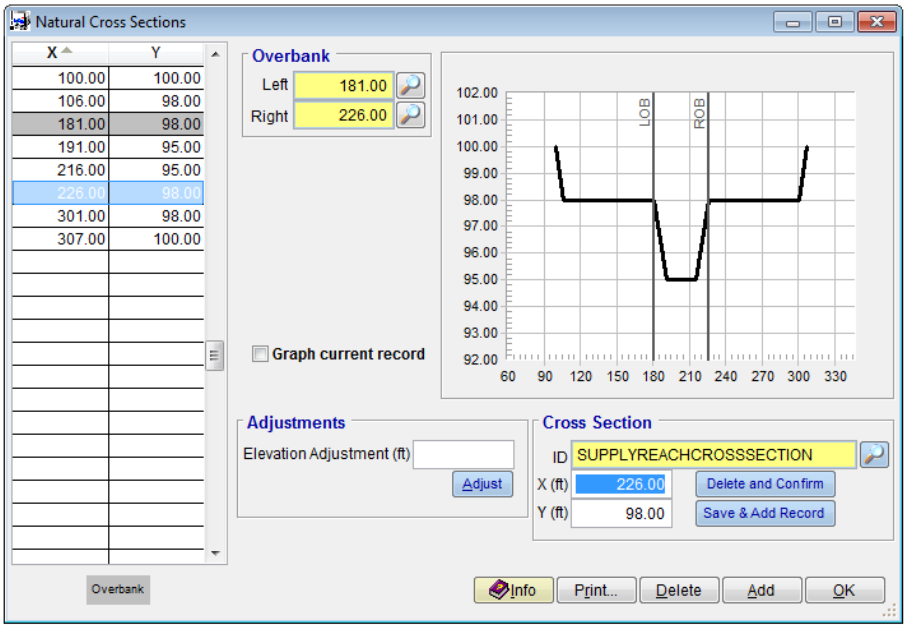
(v) On the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form, use the data provided below. Click **Import** to import the cross section data into the project. Select **Yes** to continue, and hit **OK** to close the form.

- **Import Project Reference:** *PROJECTXSECTIONS*
- **Option:** *Specific Cross Sections*

- **Import Cross Section ID:** *SUPPLYREACHCROSSSECTION*



To check if the cross section data has been successfully imported, open the **NATURAL CROSS SECTIONS** form (**River Mechanics ➔ Cross Section Geometry**).



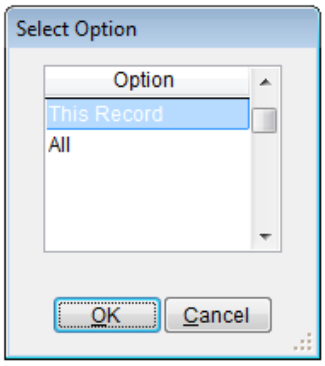
(w) Go back to the main application window, and click **River Mechanics➔ Cross Section Hydraulics** from the menu bar to open the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form. Highlight the *"SUPPLYREACHCROSSSECTION" and enter the following data:*

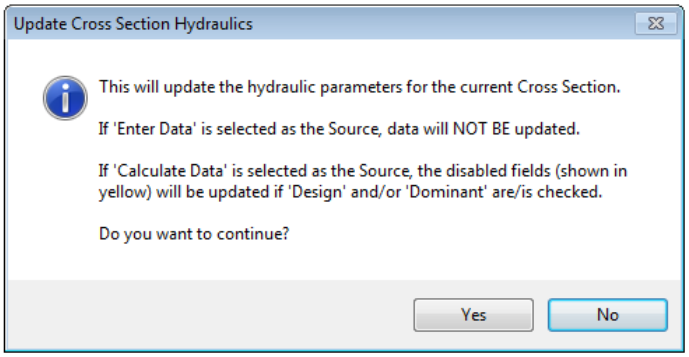
- **Uncheck Total Scour**
- **Design Flow Rate (cfs):** *3200*
- **Dominant Flow Rate (cfs):** *800*
- **Design and Dominant Slope (ft/ft):** *0.010*
- **Design and Dominant Manning's n Channel:** *0.030*
- **Design and Dominant Manning's n LOB, and ROB:** *0.045*

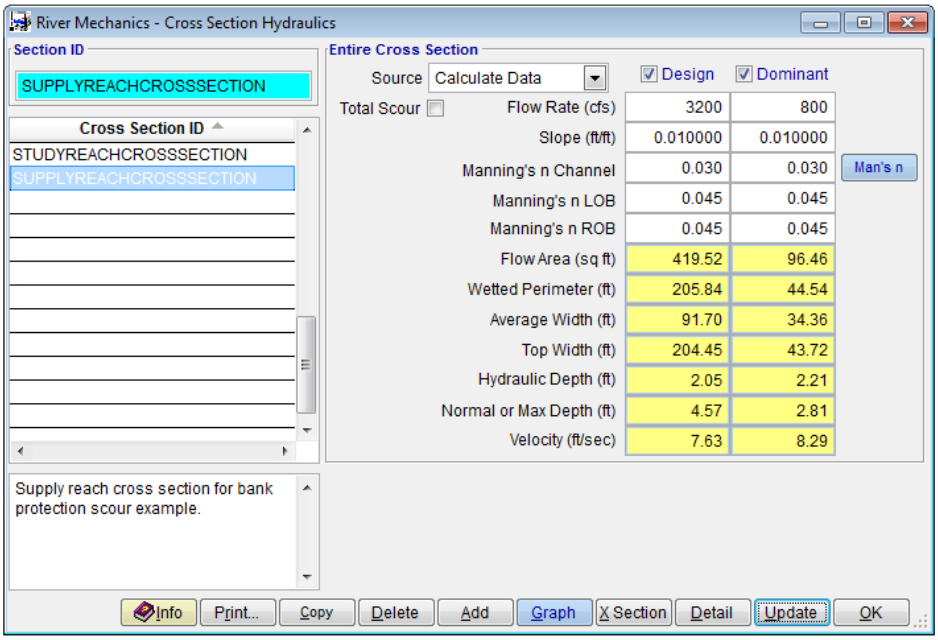
(x) Click the **Save** button to save the data.

(y) Click the **Update** button to update the hydraulic analysis results.

(z) On the **SELECT OPTION** form, select *"This Record"* and click **OK**. Hit **Yes** to continue.







(aa) Click **OK** to close the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form.

Creating the two cross sections and evaluating their respective hydraulics in **Step 2** are essential steps before proceeding to **Step 3** of this tutorial.

2.1.3 Compute Total Scour (Step 3)

A. Set up Total Scour Basic Data

(a) From the menu bar of the main application window, click **River Mechanics➔ Scour**, to open the **TOTAL SCOUR** form.

(b) Click the **Add** button on the **TOTAL SCOUR** form to activate the data entry fields.

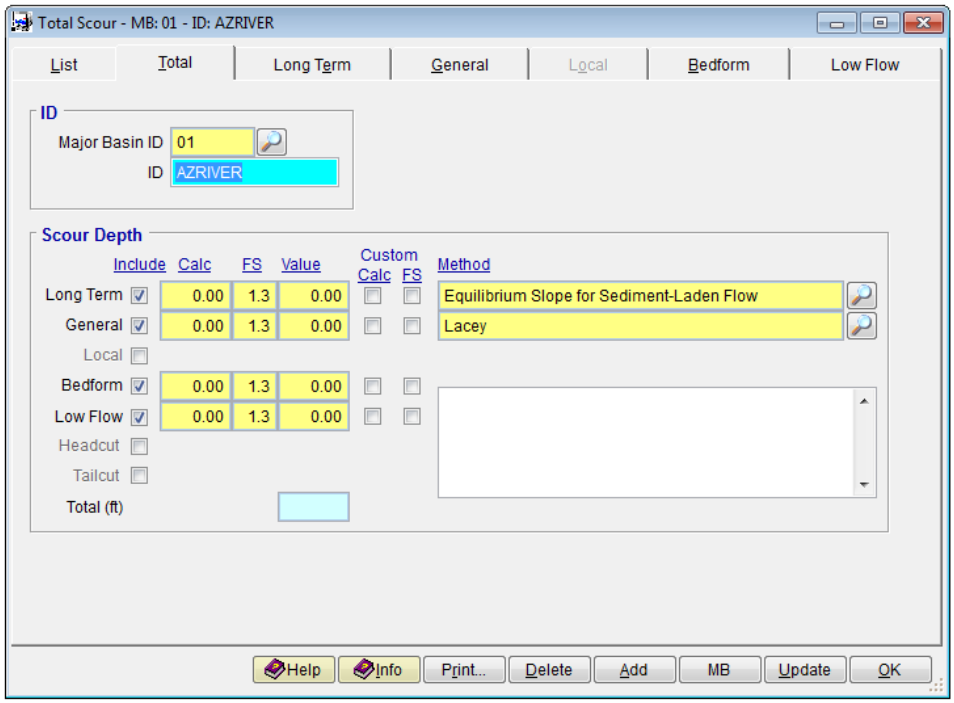
(c) Type "*AZRIVER*" into the **ID** textbox.

(d) Check the check boxes for **Long Term, General, Bedform,** and **Low Flow** (Note: Do not check **Local**)

(e) Click the browse button  in the **Method** column across **Long Term** check box and select *"Equilibrium Slope for Sediment-Laden Flow"*.

(f) Click the browse button  in the **Method** column across **General** check box and select *"Lacey"* method from the **SELECT METHOD** form to identify the method to use for General scour analysis.

(g) Click the **Save** button to save the entered data. The **TOTAL SCOUR** form should look like the following figure.



B. Calculate the Long Term Scour

(a) Select the **Long Term** tab on the **TOTAL SCOUR** form to evaluate the Long Term Scour.

(b) Click browse button beside the **Study Reach Cross Section ID** to select the cross section ID "*STUDYREACHCROSSSECTION*".

(c) Click browse button beside the **Supply Reach Cross Section ID** to select the cross section ID "*SUPPLYREACHCROSSSECTION.*

(d) Enter the **D50 (mm)** values"*2.0"* and "*1.5"* for **Supply** and **Study**, respectively.

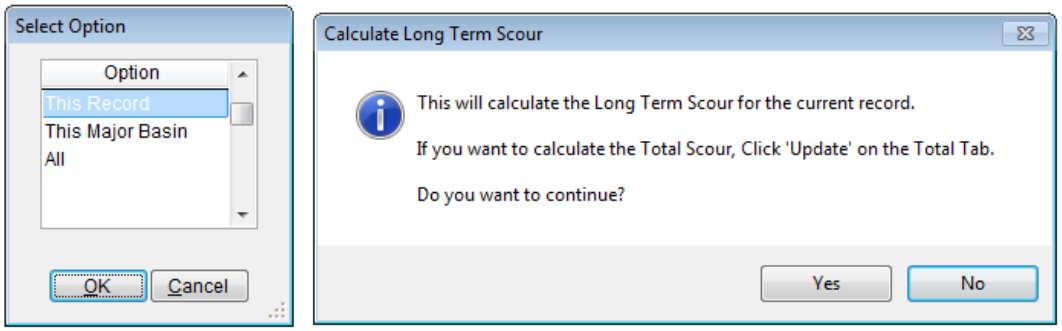
(e) Enter the **D84 (mm)** values "*12"* and "*10"* for **Supply** and **Study**, respectively.

(f) Enter the **D16 (mm)** values "*1.0"* and "*0.5"* for **Supply** and **Study**, respectively.

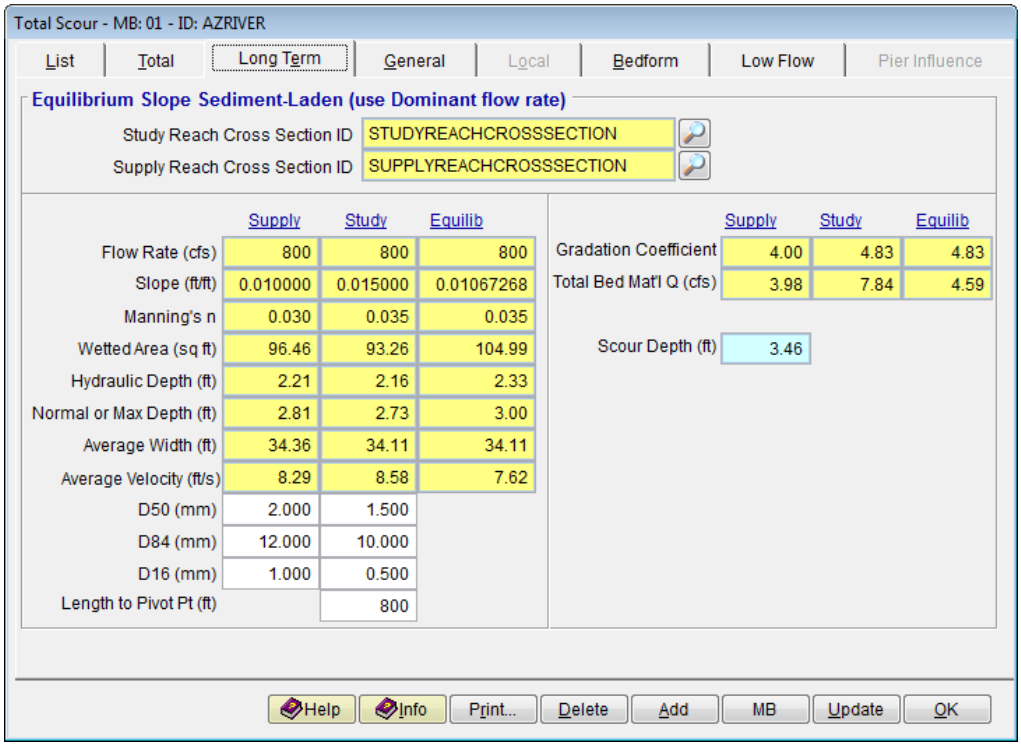
(g) Enter "*800"*into **Length to Pivot Pt (ft)** textbox

(h) Click the **Save** button to save the entered data.

(i) Click the **Update** button to start the computation; select *"This Record"* from the **SELECTION OPTION** window, and click **Yes** to continue.



After the update, the final result of the **Long Term Scour calculation** is shown in the following figure.



C. Calculate the General Scour

(a) Click the **General** tab on the **TOTAL SCOUR** form to evaluate the General Scour.

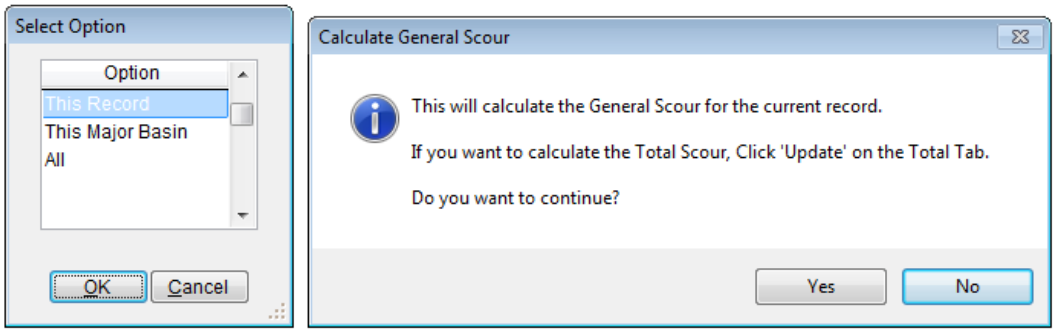
(b) Click browse button beside the **Cross Section ID** to select the cross section ID "*STUDYREACHCROSSSECTION*".

(c) Enter "*1.5"* into the **D50 (mm)** textbox.

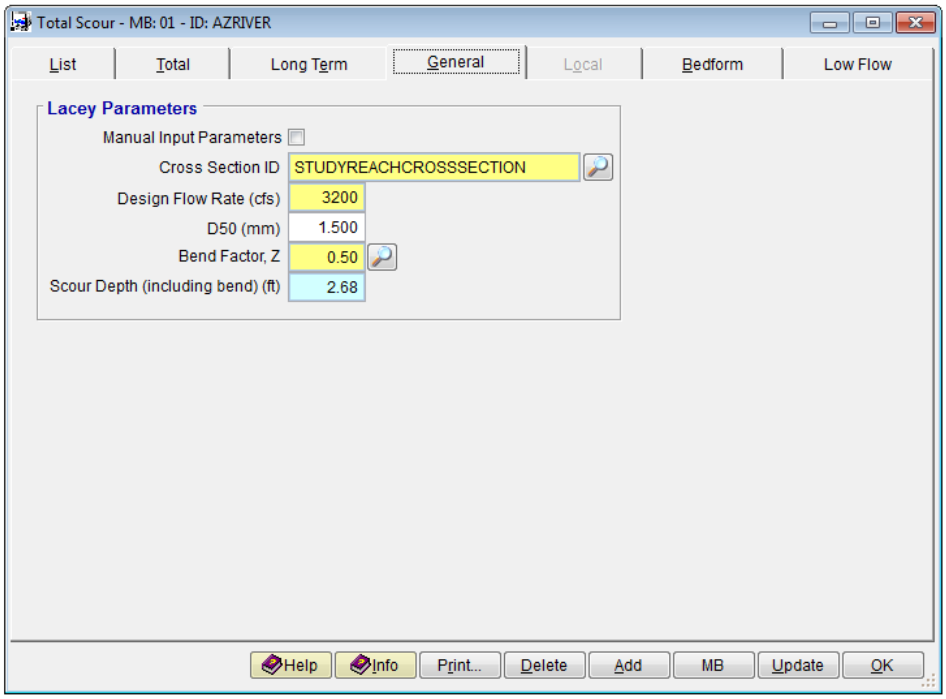
(d) Click the browse button beside the **Bend Factor, Z** and select "*Moderate Bend"*.

(e) Click the **Save** button to save the entered data.

(f) Click the **Update** button and select "*This Record"* from the **SELECTION OPTION** window. Click **Yes** on the **CALCULATE GENERAL SCOUR** form to proceed.



After the update, the final result of the general term scour calculation is shown in the following figure.



D. Calculate the Bedform Scour

In this section, a procedure on how to calculate the Bedform scour will be provided.

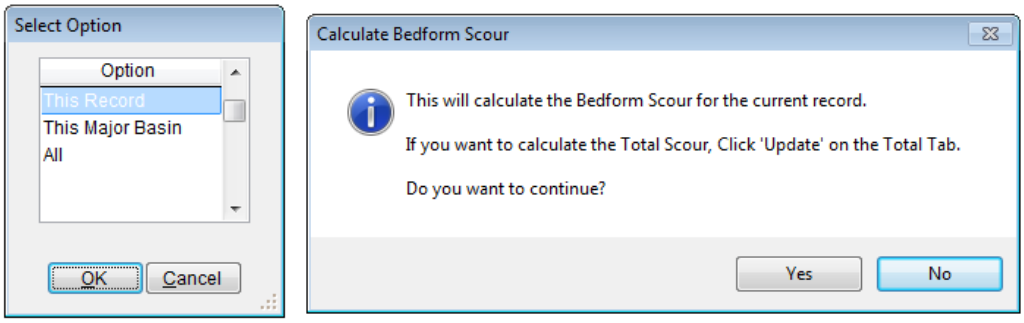
(a) Click the **Bedform** tab on the **TOTAL SCOUR** form to evaluate the Bedform Scour.

(b) Click the browse button beside the **Cross Section ID** to select the cross section **ID** "*STUDYREACHCROSSSECTION*".

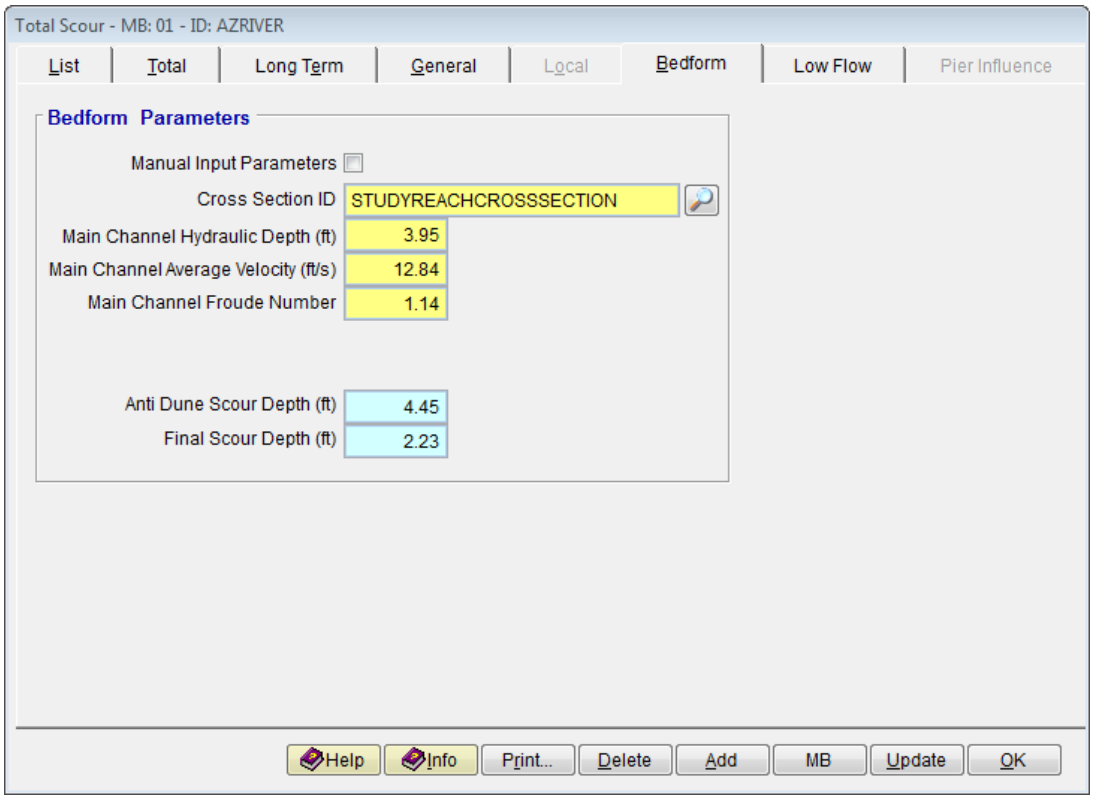
(c) Set the **Dune Height/Depth** value to "*0.20*".

(d) Click the **Save** button to save the data just entered.

(e) Click the **Update** button and select "*This Record*" from the **SELECTION OPTION** window. Click **Yes** on the **CALCULATE BEDFORM SCOUR** form to proceed.



After the update, the final result of the bedform scour calculation is shown in the following figure.



E. Calculate the Low Flow Scour

In this section, a procedure on how to calculate the low-flow scour will be provided.

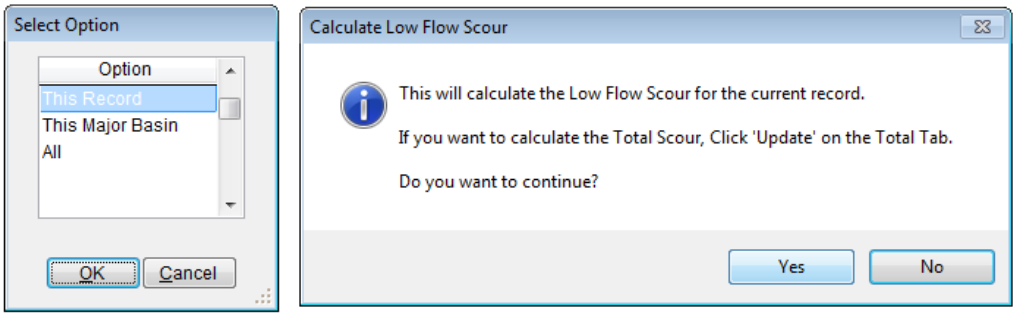
(a) Click the **Low Flow** tab on the **TOTAL SCOUR** form to evaluate the Low Flow Scour.

(b) Enter "*100*" into the **Low Flow Rate (cfs)** textbox.

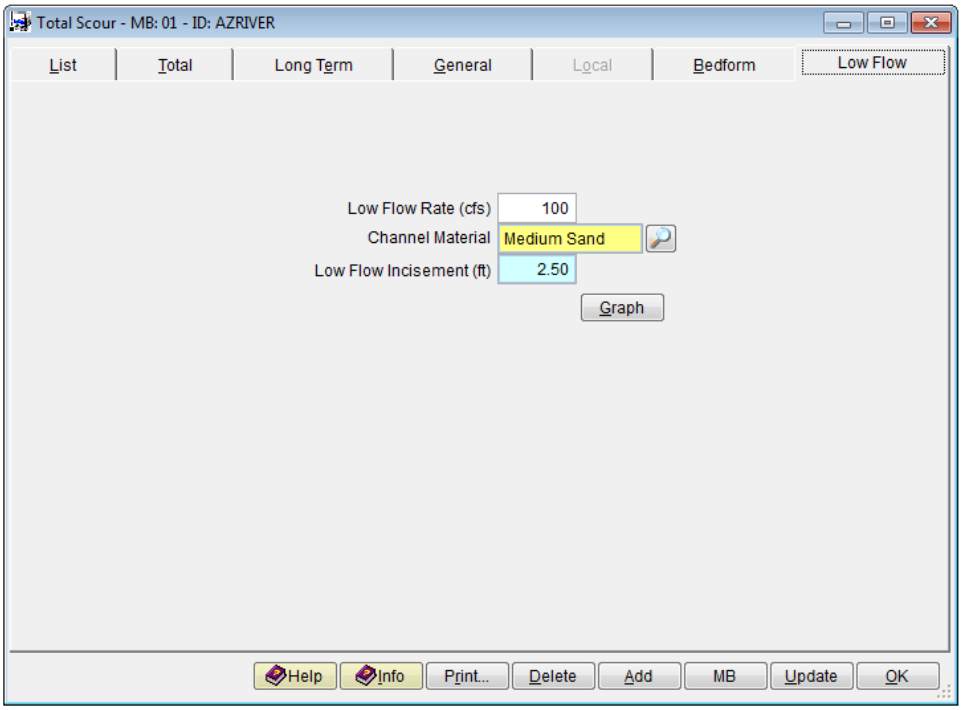
(c) Click the browse button beside the **Channel Material** to select the channel material data and choose *"Medium Sand"*.

(d) Click the **Save** button to save the data just entered.

(e) Click the **Update** button and select "*This Record*" from the **SELECTION OPTION** window. Click **Yes** on the **CALCULATE GENERAL SCOUR** form to proceed.

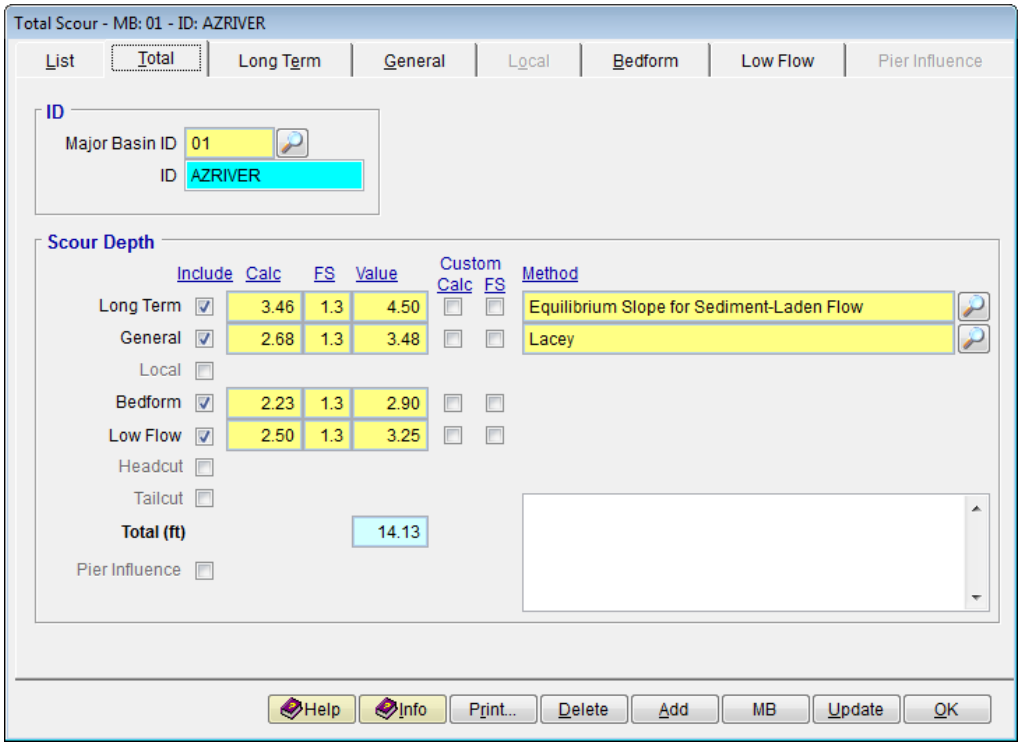


After the update, the final result of the low flow scour calculation is shown in the following figure.



F. Calculate the Total Scour

On the **TOTAL SCOUR** form, select the **Total** tab. The following figure shows what the form looks like. As shown, the analysis results for the total scour which is the combination of the individual scour components previously analyzed are displayed.



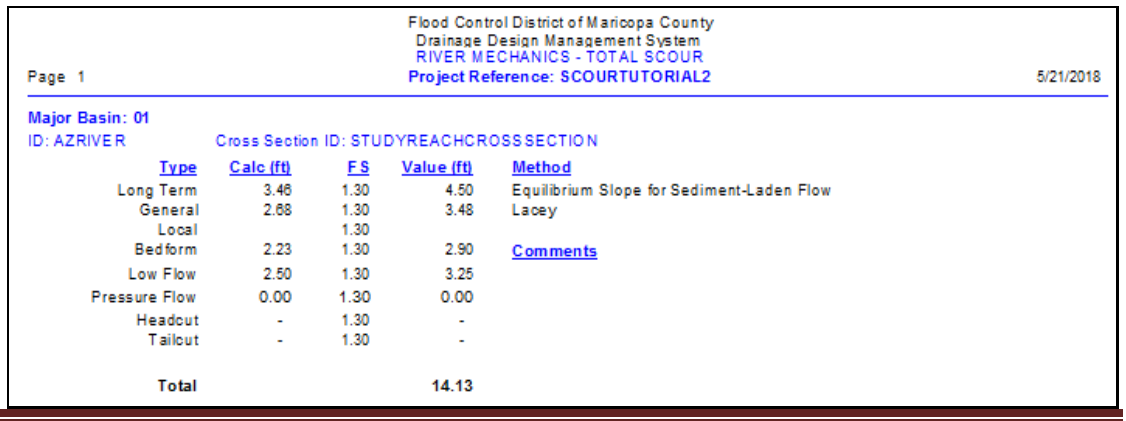
2.1.4 Report and Documentation of Results (Step 4)

In this section, procedures will be given on how to view, print, and export the calculation results for the total scour analysis.

The total scour is the sum of the long term scour, general scour, local scour, bedform scour and low flow scour. In this tutorial, only four scour components are covered, namely, the long term scour, general scour, bedform scour and low flow scour.

Make sure all the four scours listed above are checked in the **Total** tab and all the listed scours are updated.

(a) To view the results on the screen, click the **Print …** button on the **TOTAL SCOUR – MB: 01 – ID: AZRIVER** form, a report will be generated as shown in the following figure.



Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - TOTAL SCOUR
Page 1 — Project Reference: SCOURTUTORIAL2 — 5/21/2018

Major Basin: 01
ID: AZRIVER Cross Section ID: STUDYREACHCROSSSECTION

Type	Calc (ft)	FS	Value (ft)	Method
Long Term	3.46	1.30	4.50	Equilibrium Slope for Sediment-Laden Flow
General	2.68	1.30	3.48	Lacey
Local		1.30		
Bedform	2.23	1.30	2.90	Comments
Low Flow	2.50	1.30	3.25	
Pressure Flow	0.00	1.30	0.00	
Headcut	-	1.30	-	
Tailcut	-	1.30	-	
Total			**14.13**	

(b) To print out the results on a printer, click the printer symbol ().

(c) To export the results in PDF format or other formats, click the export symbol ()

(d) The individual scour component results and cross section hydraulics results can also be viewed, printed, and exported by clicking the **Print…** button under individual component scour menus and **Cross Section Hydraulics** menu.

2.2 Riprap Sizing for Bank Protection

Estimate the riprap size for bank protection using "*Channel Banks on Curved Reach*".

1. Calculate the Riprap Size

2. Report and Document the Results

2.2.1 Calculate the Riprap Size

(a) From the menu bar of the main application window, click **River Mechanics** ➔ **Riprap** to open the **RIVER MECHANICS - RIPRAP** window.

(b) Click **Add** button on the **RIVER MECHANICS - RIPRAP** window.

(c) Enter "*CHNL1*" into the **Location ID** textbox

(d) Browse for "*Channel Banks on Curved Reach*" in the **Type** textbox

(e) Click **OK** on the **SELECT TYPE** dialog box.

(f) Check **Use Cross Section ID** check box

(g) Browse for "*STUDYREACHCROSSSECTION*" in the **Section ID** textbox.

(h) Click **OK** on the **SELECT CROSS SECTION ID** dialog box.

(i) Enter "*3:1*" into the **Bank Slope (H:V)** textbox

(j) Enter "*150.00*" into the **Specific Weight Stone (lb/cu ft)** textbox

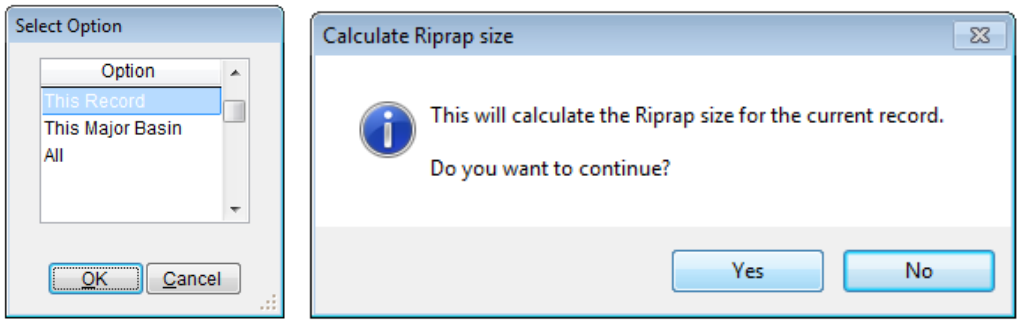
(k) Enter "*62.43*" into the **Specific Weight Water (lb/cu ft)** textbox (if not entered)

(l) Select "*Angular*" from the drop down for Riprap **Type** in the **Safety Factor** frame.

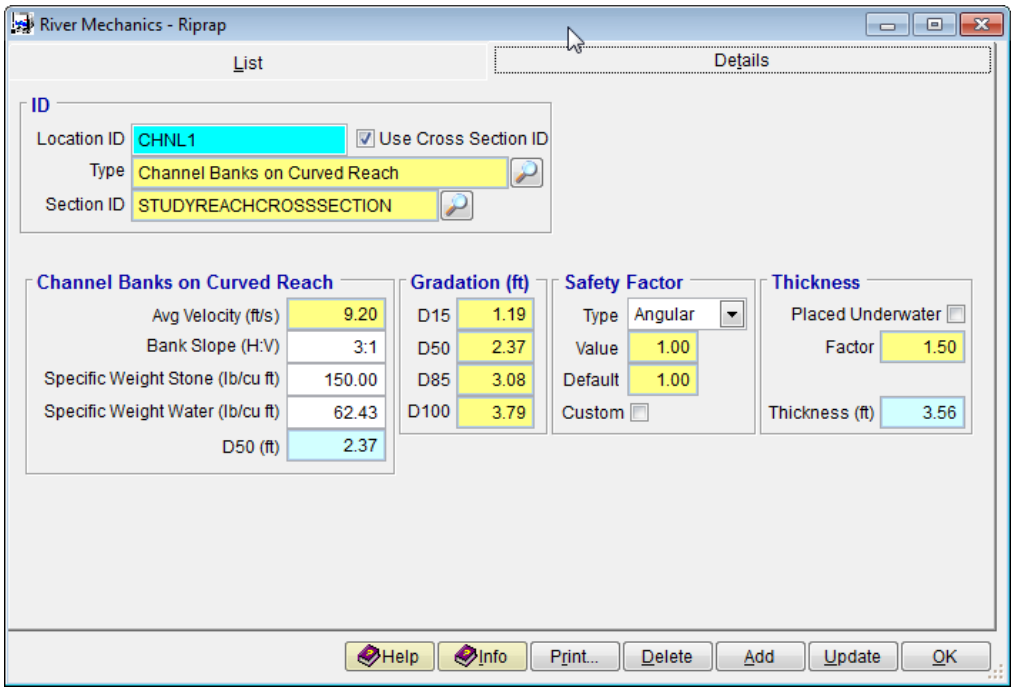
(m) Click the **Save** button.

(n) Click **Update** button to compute riprap median size **D50 (ft)**.

(o) Highlight "*This Record*" in the **SELECTION OPTION** window and click **OK**. Click **Yes** when the **CALCULATE RIPRAP SIZE** dialog box opens.

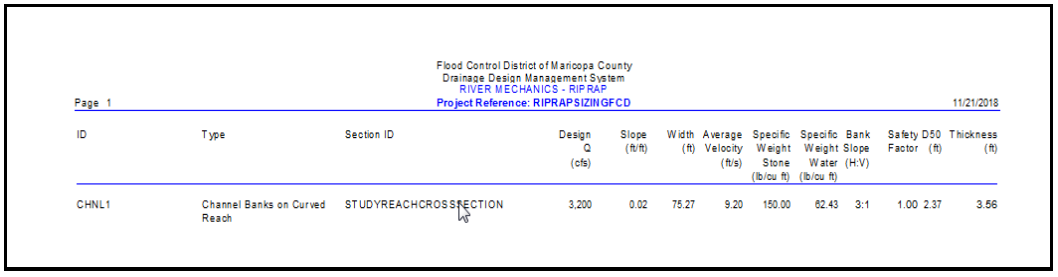


After the update process is finished, the window looks like what is shown in the following figure. Click **OK** to close the window.



2.2.2 Report and Document the Results

(a) Click the **Print …** button on the **RIVER MECHANICS – RIPRAP** window. A report will be generated as is shown in the following figure.



This concludes this tutorial for riprap size for bank protection.

2.3 Launchable Riprap for Bank Protection

Estimate the launchable riprap size for bank protection using "*Channel Banks on Curved Reach*".

1. Calculate Launchable Riprap Size
2. Report and Document the Results

2.3.1 Calculate Launchable Riprap Size

(a) From the menu bar of the main application window, click **River Mechanics** ➔ **Launchable Riprap** to open the **RIVER MECHANICS – LAUNCHABLE RIPRAP** window.

(b) Click **Add** button on the **RIVER MECHANICS – LAUNCHABLE RIPRAP** window.

(c) Enter "*CHNL1*" into the **Location ID** textbox

(d) Enter *"12.71"* into the **Total Scour Depth, Z_t (ft)** textbox. (Note this value can be linked to a value already calculated by browsing for the data and selecting the **Import Project Reference** and **Import ID**)

(e) Enter *"2.37"* into the **D50 (ft)** textbox. (Note this value can be linked to a value already calculated by browsing for the data and selecting the **Import Project Reference** and **Import ID**)

(f) Check **Elevations** check box in the **Vertical Launch Distance** frame.

(g) Enter "*98.00"* in the **Top of Toe Protection Elev, EL_{top} (ft)** textbox.

(h) Enter "*95.00"* in the **Channel Thalweg Elev, EL_{tg} (ft)** textbox.

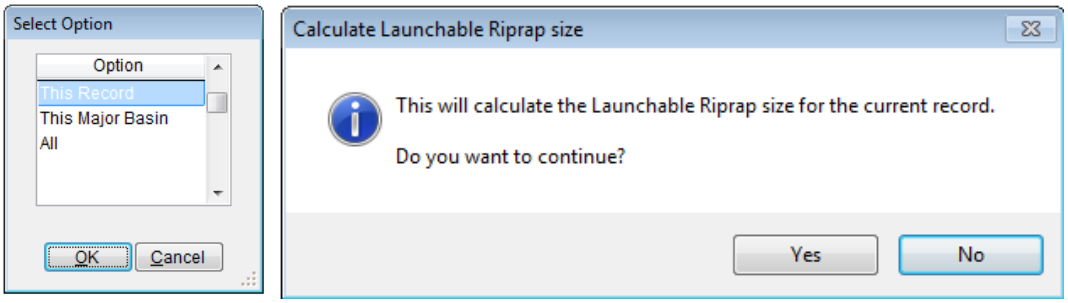
(i) Select "*Dry*" for the **Placement** in the **Volume Increase** frame**.**

(j) Select *"Sand"* for the **Channel Bed Material** in the **Volume Increase** frame.

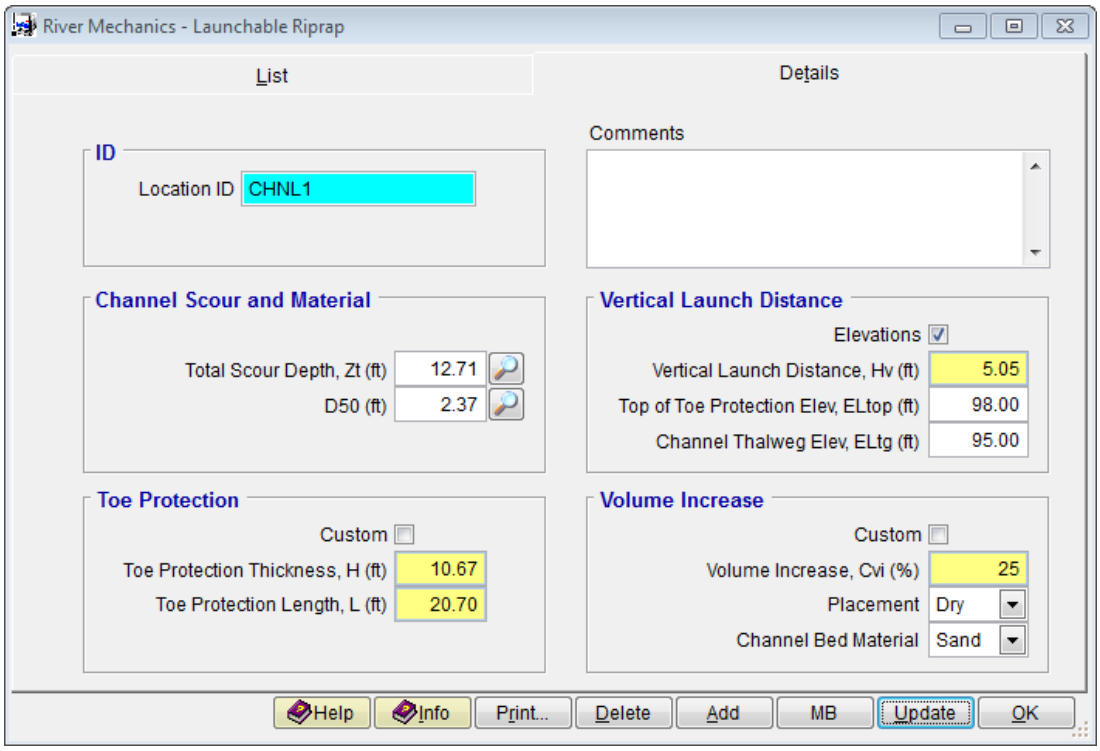
(k) Click the **Save** button.

(l) Click **Update** button to compute launchable riprap parameters.

(m) Highlight "*This Record*" in the **SELECTION OPTION** window and click **OK**. Click **Yes** when the **CALCULATE LAUNCHABLE RIPRAP SIZE** dialog box opens.

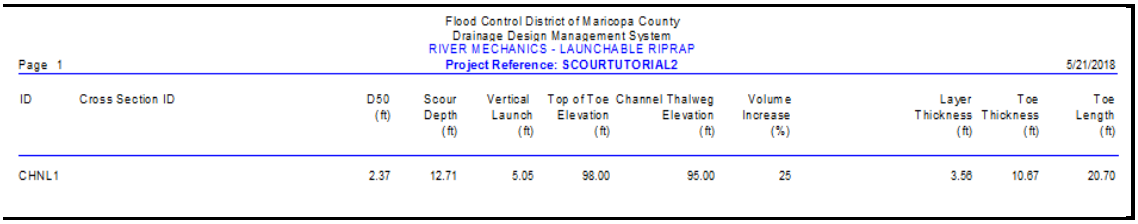


After the update process is finished, the window looks like what is shown in the following figure. Click **OK** to close the window.



2.3.2 Report and Document the Results

Click the **Print …** button on the **RIVER MECHANICS – LAUNCHABLE RIPRAP** window. A report will be generated as is shown in the following figure.



Flood Control District of Maricopa County
Drainage Design Management System
RIVER MECHANICS - LAUNCHABLE RIPRAP
Project Reference: SCOURTUTORIAL2

Page 1 5/21/2018

ID	Cross Section ID	D50 (ft)	Scour Depth (ft)	Vertical Launch (ft)	Top of Toe Elevation (ft)	Channel Thalweg Elevation (ft)	Volume Increase (%)	Layer Thickness (ft)	Toe Thickness (ft)	Toe Length (ft)
CHNL1		2.37	12.71	5.05	98.00	95.00	25	3.56	10.67	20.70

This concludes this tutorial for launchable riprap size for bank protection.

2.4 Lateral Erosion

Estimate the Lateral Erosion corridor for a watercourse as a basis to protect the public from potential hazard situation.

Calculation of Lateral Erosion Distance are made on the following basis:

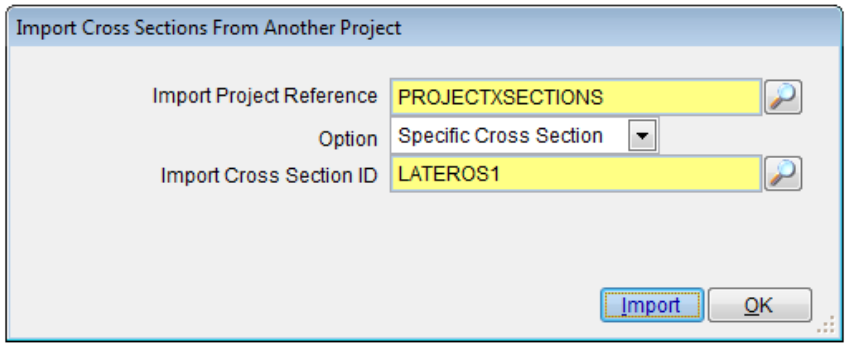
A. No Data Available
B. Scour Data Available
C. Scour and Historical Data Available
D. Scour, Historical and Cross Section Data Available

2.4.1 Prepare the Cross Section and Hydraulics Data

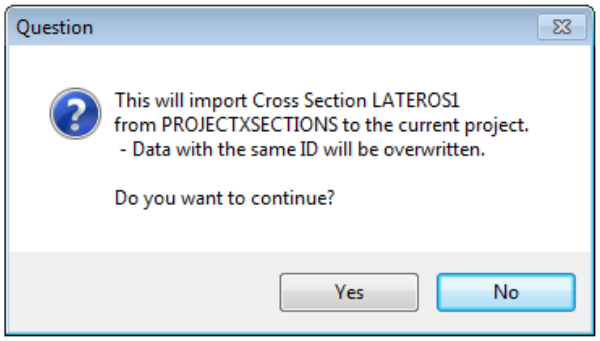
To develop the cross section and hydraulic data to be used for this project, the *"LATEROS1"* dataset will be used which will be imported from another project.

(a) From the menu bar of the main application window, click **River Mechanics** ➔ **Import Cross Sections from Another Project** to open the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form.

(b) On the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form, select the settings shown on the following form:

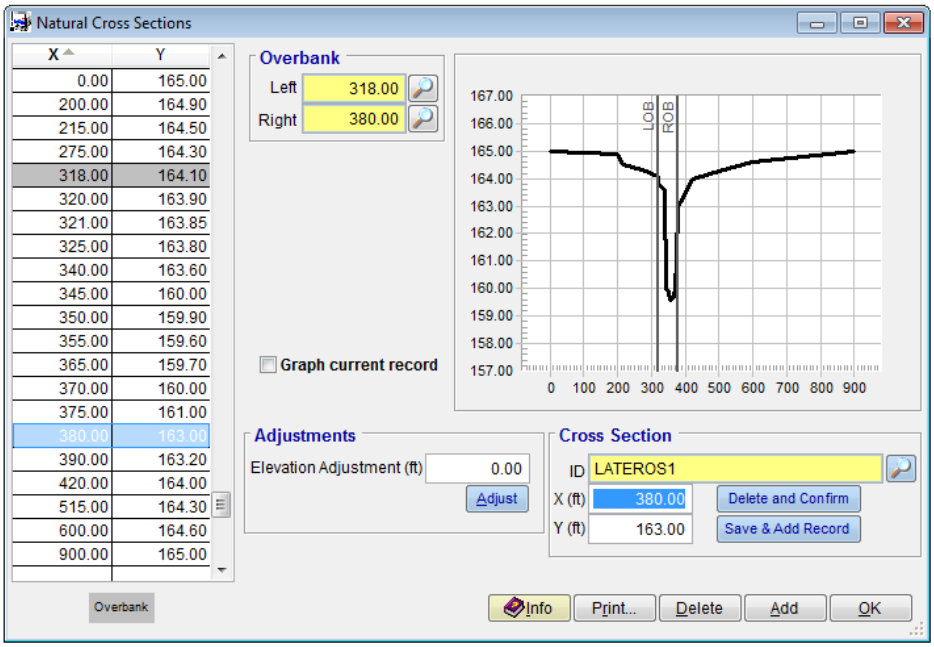


(c) Once the specified data has been selected, click the **Import** button. Select **Yes** to proceed, and hit **OK** to close the **IMPORT CROSS SECTION FROM ANOTHER PROJECT** form.

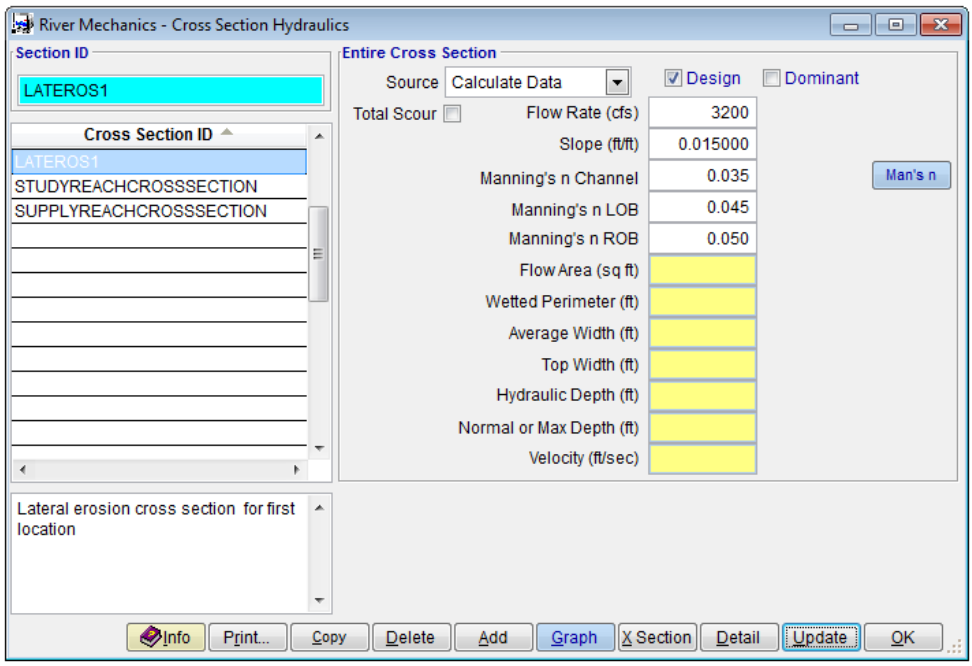


(d) To check if the lateral erosion cross section data has been successfully imported, open the **NATURAL CROSS SECTIONS** form (**River Mechanics ➔ Cross Section Geometry**).

(e) On the form, select *"LATEROS1"* for the **Cross Section ID** by clicking the Selector button at the right side of the **ID** textbox. After inspection, close the **NATURAL CROSS SECTIONS** form by clicking **OK.**



(f) To establish the cross-section hydraulic data, open the **CROSS SECTION HYDRAULICS** form (**River Mechanics ➔ Cross Section Hydraulics**) and on the form select *"LATEROS1"* from the **Cross Section ID** listing, check the box **Design** and select *"Calculate Data"* in the **Source** drop down list if not already selected or checked. Now enter the data shown on the following form:

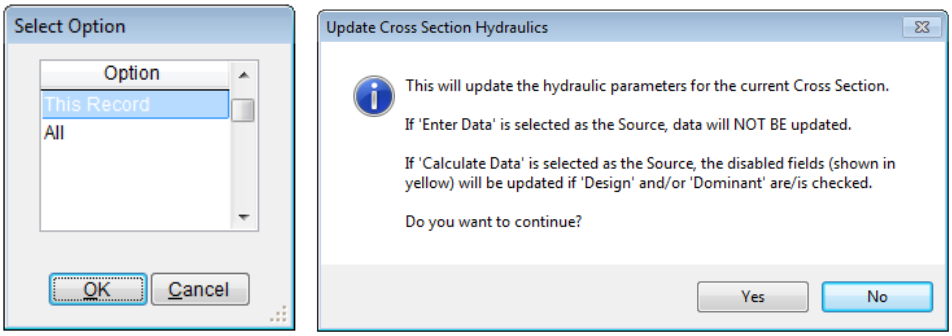


(g) Click **Save** to save the edits.

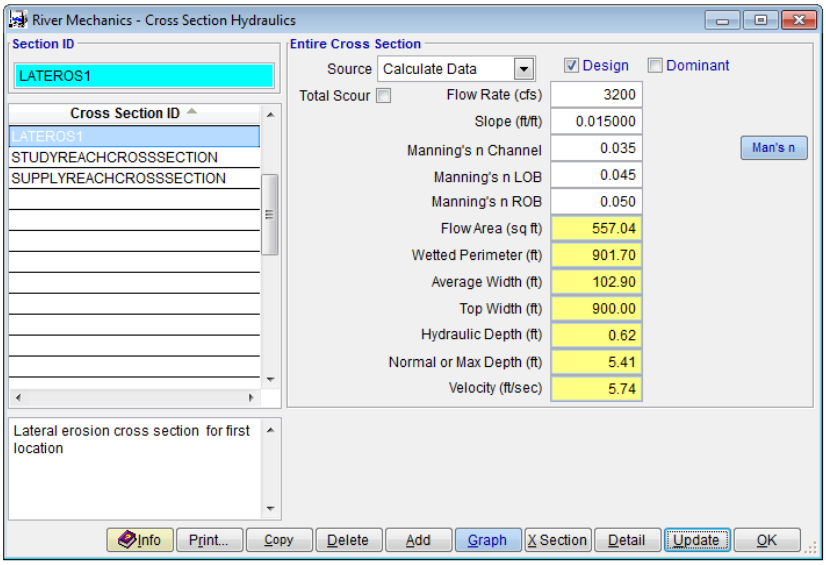
(h) To recalculate or update the hydraulic analysis on this form, click **Update**.

(i) Select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.

(j) Click ***Yes*** on the **UPDATE CROSS SECTION HYDRAULICS** form to continue.



(k) The results are shown on the following form:



(l) Click **OK** to close the form.

2.4.2 Calculate the Lateral Erosion Distance

Four (4) analysis scenarios will be presented in this tutorial. These different scenarios are dependent on the availability of data for analysis. These scenarios include: (a) no data; (b) with scour data; (c) with scour and historical data; and (d) with scour, historical, and cross section data.

A. Scenario #1 – No Data

(a) On the **RIVER MECHANICS – LATERAL EROSION** form (**River Mechanics ➔ Lateral Erosion➔ Details** tab).

(b) Click **Add** to enter a new data and type in "*LOCID*" on the **Location ID** textbox and then make sure that all the check boxes in the **Available Data** frame are unchecked.

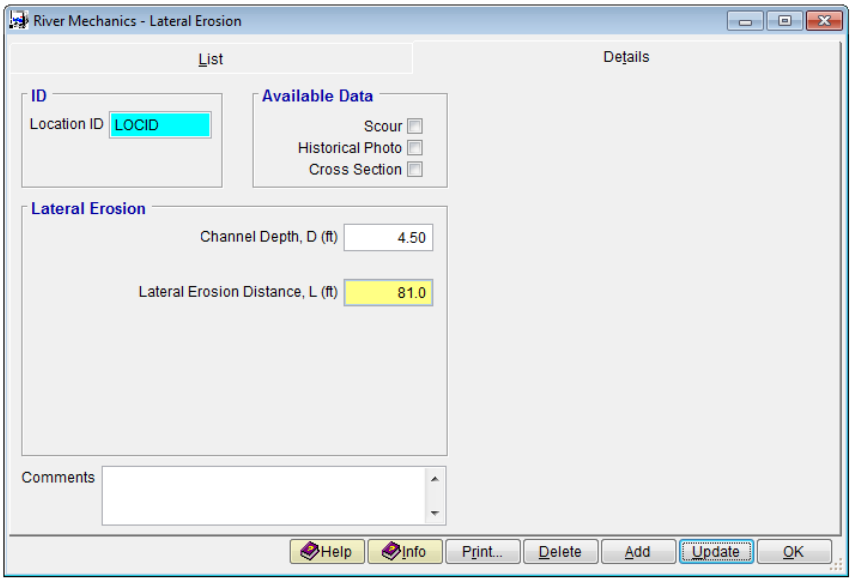
(c) Type in "*4.5*" into the **Channel Depth, D (ft)** textbox. This information is assumed to be the field estimate made on the channel depth.

(d) Click ***Save*** to save the data entered.

(e) To calculate the **Lateral Erosion Distance, L (ft)**, click the ***Update*** button and select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.

(f) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.

The following screen capture below shows the results of the analysis. The only data used was a field estimate of the **Channel Depth, D (ft)** at the location of interest.



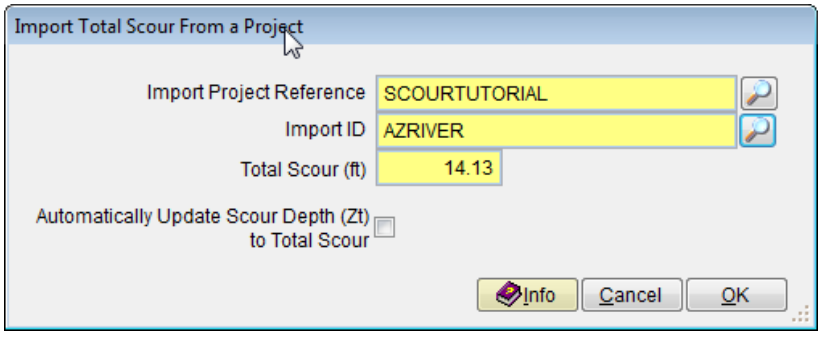
B. Scenario #2 – Scour Data Available

(a) Now check the **Scour** checkbox and leave the other two checkboxes unchecked.

(b) Keep the value of the **Channel Depth, D (ft)** at *"4.50"*. Click **Save.**

(c) Import the value from a scour analysis project. To use this feature, click the magnifying glass across the **Scour Depth, Zt (ft)** textbox.

(d) On the **IMPORT TOTAL SCOUR FROM A PROJECT** form, use the data as shown:

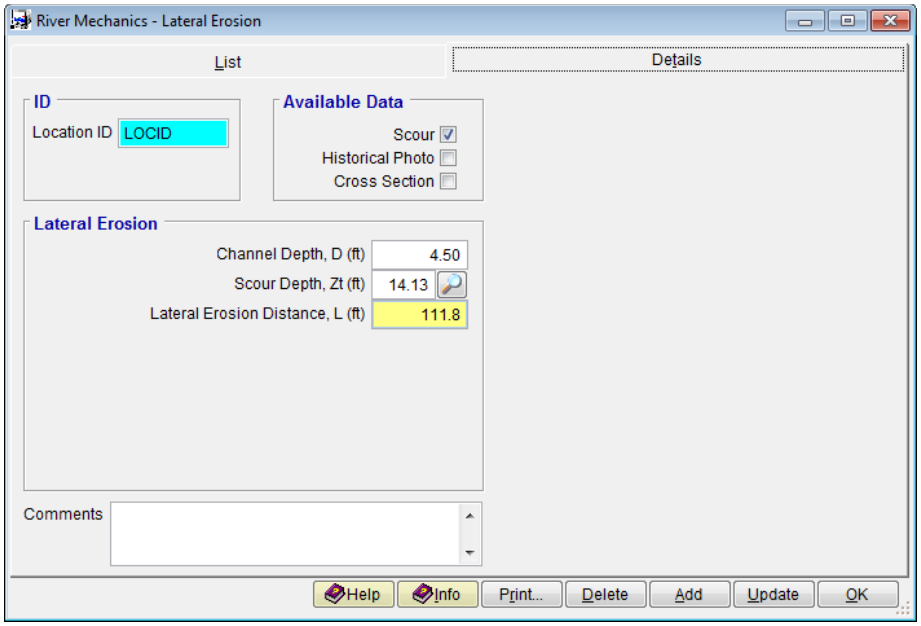


(e) Click ***OK*** to close the form.

(f) To calculate the **Lateral Erosion Distance, L (ft**), click the ***Update*** button and select "*This Record*" from the **SELECT OPTION** form. Click ***OK*** to close the form.

(g) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.

The following form shows the results of the lateral erosion analysis where scour data is available.



C. Scenario #3 –Scour and Historical Data Available

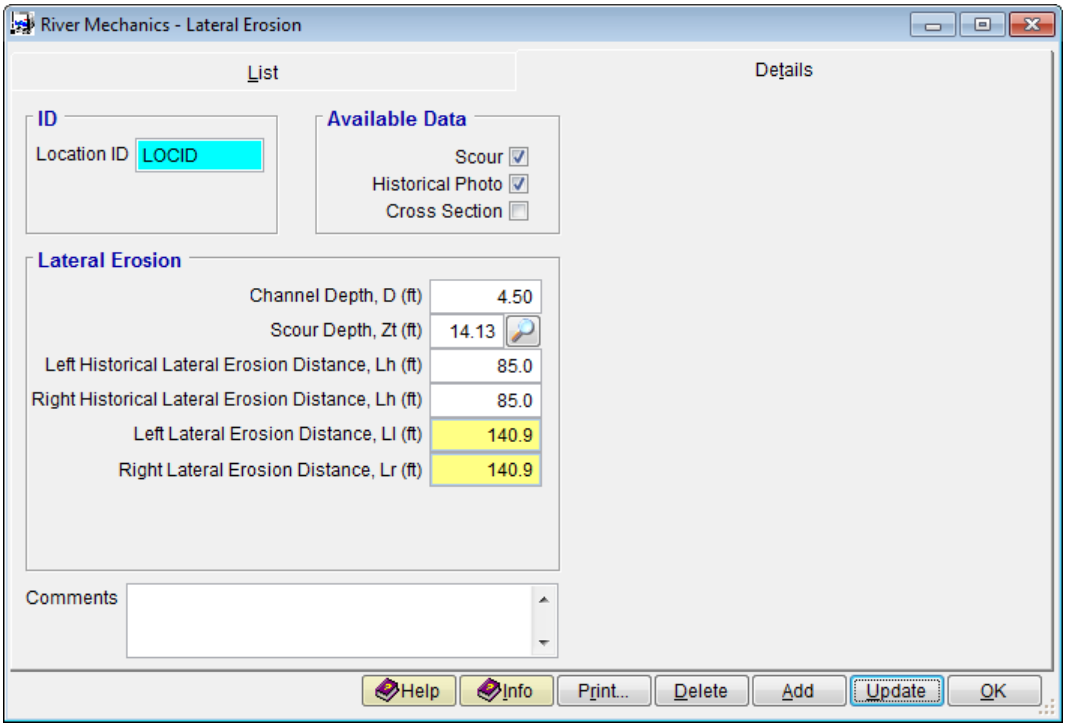
(a) Now make sure that the **Scour** and **Historical Photo** checkboxes are checked. Leave the **Cross Section** checkbox unchecked.

(b) Type in "*85.0*" into the **Left Historical Lateral Erosion Distance, Lh (ft)** and the **Right Historical Lateral Erosion distance, Lh (ft)** textboxes. Leave the **Channel Depth** and **Scour Depth, Zt (ft)** unchanged. Click ***Save*** to save the data.

(c) To calculate both the **Left Lateral Erosion Distance, L_l (ft)** and the **Right Lateral Erosion Distance, L_r (ft)**, click the ***Update*** button and select "*This Record"* from the **SELECT OPTION** form. Click ***OK*** to close the form.

(d) Click ***Yes*** when the **CALCULATE LATERAL EROSION** form opens.

The following form shows the results of the lateral erosion analysis where scour and historical data are available.



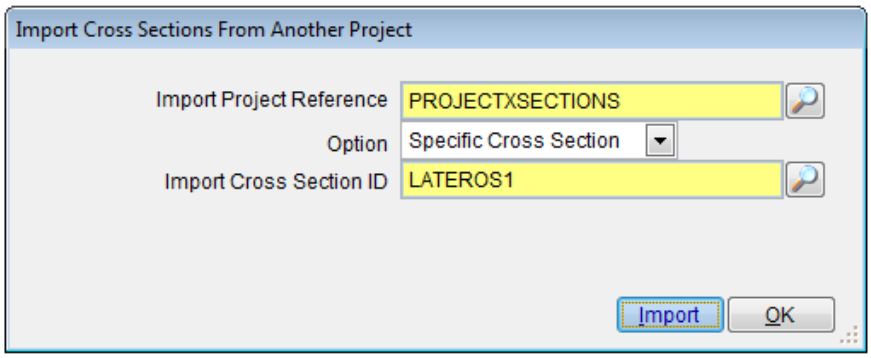
D. Scenario #4 –Scour, Historical and Cross Section Data Available

(a) Make sure that all the checkboxes (i.e., **Scour, Historical Photo,** and **Cross Section)** are checked.

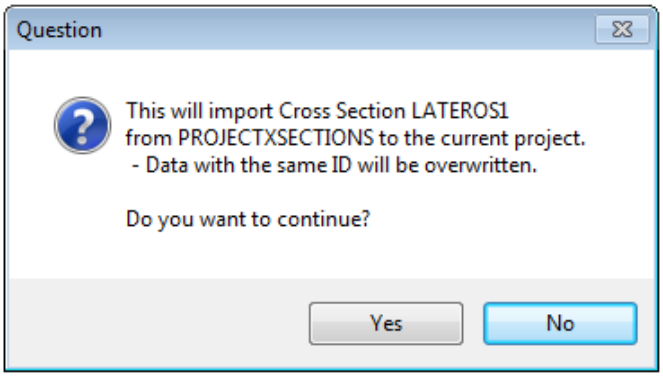
To develop the cross section and hydraulic data to be used for this project, the *"LATEROS1"* dataset will be used which will be imported from another project.

(b) From the menu bar of main application window, click **River Mechanics ➔ Import Cross Sections from Another Project** to open the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form if not already imported.

(c) On the **IMPORT CROSS SECTIONS FROM ANOTHER PROJECT** form, select the settings shown on the following form:

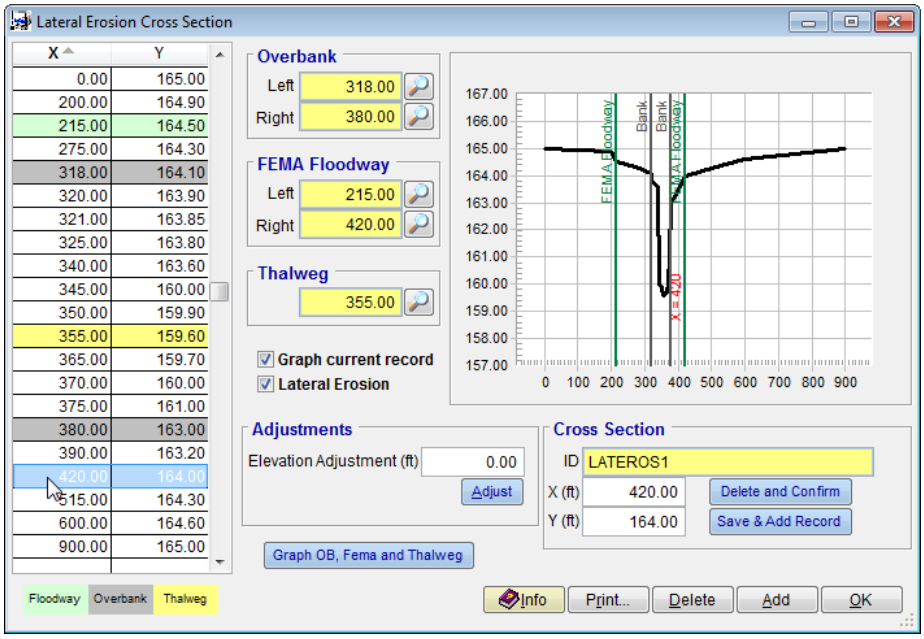


(d) Once the specified data have been selected, click the **Import** button. Select **Yes** to proceed, and hit **OK** to close the **IMPORT CROSS SECTION FROM ANOTHER PROJECT** form.



(e) On the **RIVER MECHANICS – LATERAL EROSION FORM**, select *"LATEROS1"* for the **Cross Section ID** by clicking the Selector button at the right side of the **ID** textbox.

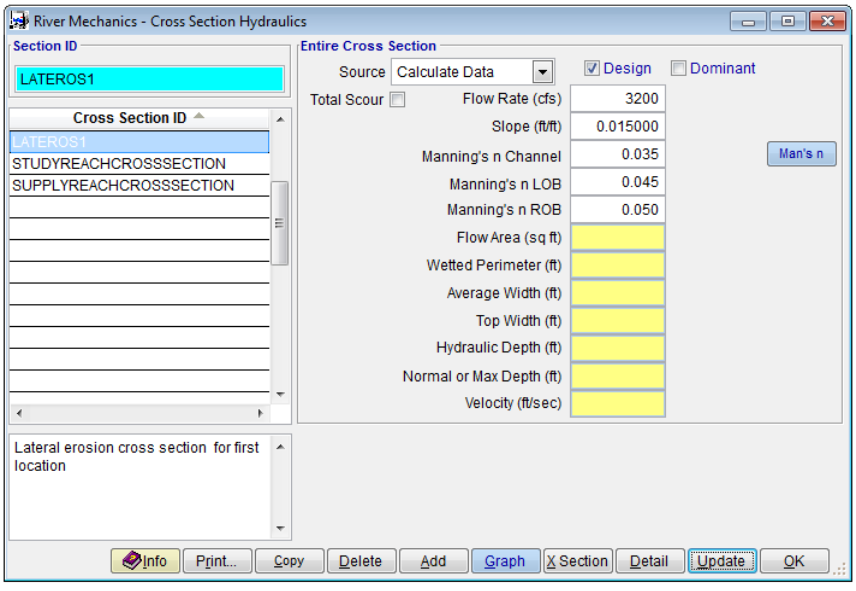
(f) To check if the lateral erosion cross section data has been successfully imported, Click on the "**X Section Data**" button to view the cross section data. Note that this form includes **Overbank, FEMA Floodway** and **Thalweg** data that is required for this analysis. See the following form.



(g) After inspection, click the **OK** button to close the **LATERAL EROSION CROSS SECTION** form.

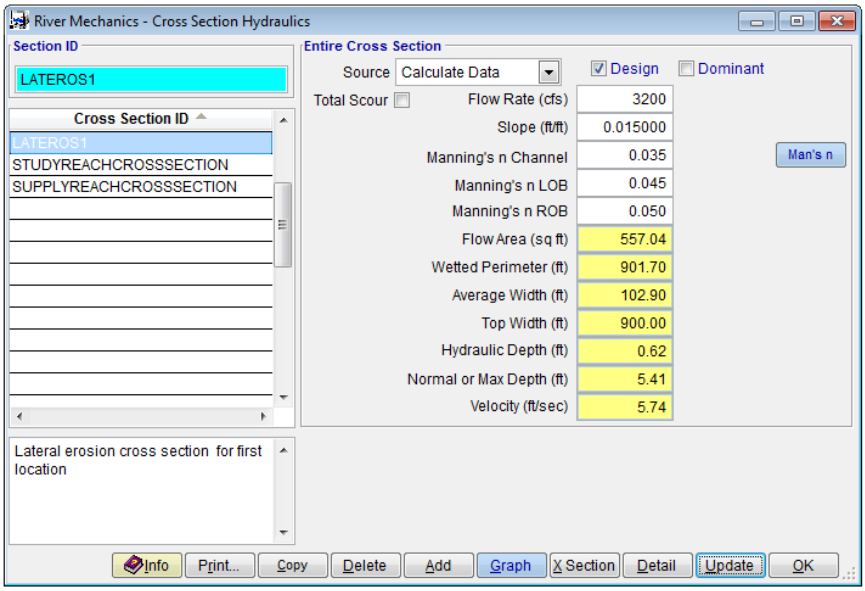
Leave the **RIVER MECHANICS – LATERAL EROSION** form open.

(h) To establish the cross-section hydraulic data, open the **RIVER MECHANICS** - **CROSS SECTION HYDRAULICS** form (**River Mechanics ➔ Cross Section Hydraulics**). On the form select *"LATEROS1"* from the **Cross Section ID** listing and enter the data shown on the following form after checking the **Design** box and selecting *"Calculate Data"* in the **Source** drop down list:



(i) Click ***Save*** to save the edits.

(j) Click ***Update*** to calculate the data. The form below shows the results.



(k) Click the **OK** button to close the **RIVER MECHANICS – CROSS SECTION HYDRAULICS** form.

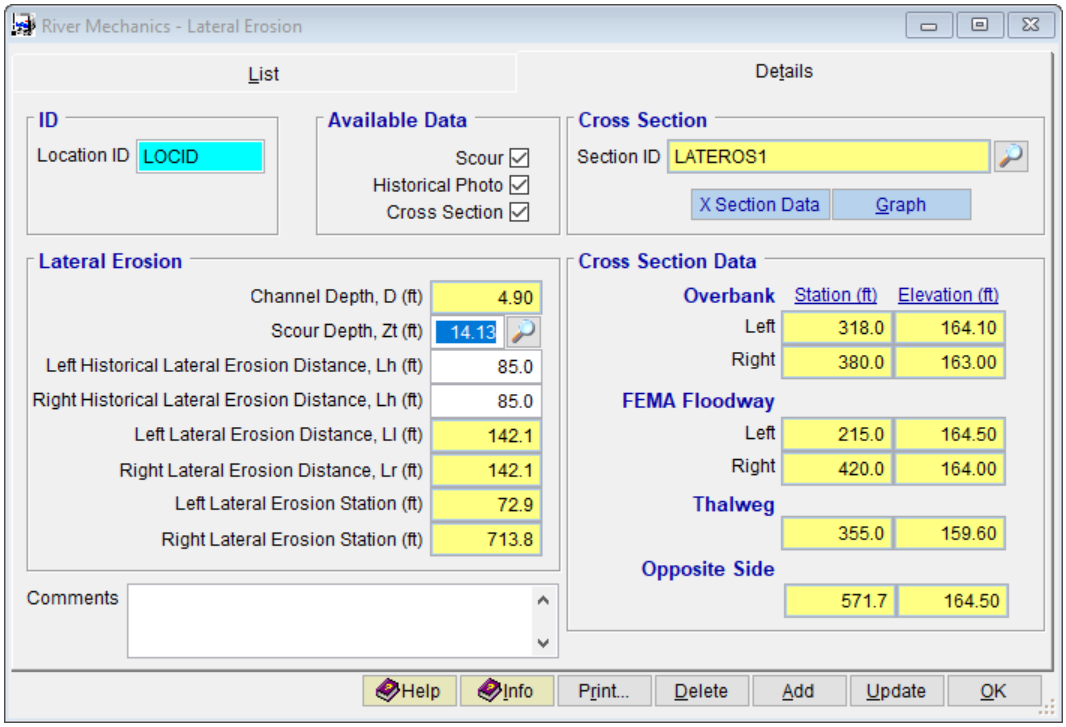
(l) To access the Cross Section Data for this project on the **RIVER MECHANICS – LATERAL EROSION** form, click the **Selector** button (Magnifying glass) to the right of the **Section ID** textbox. On the **SELECT CROSS SECTION ID** form, select the *"LATEROS1"* from the list.

(m) Click ***OK*** to close the **SELECT CROSS SECTION ID** form.

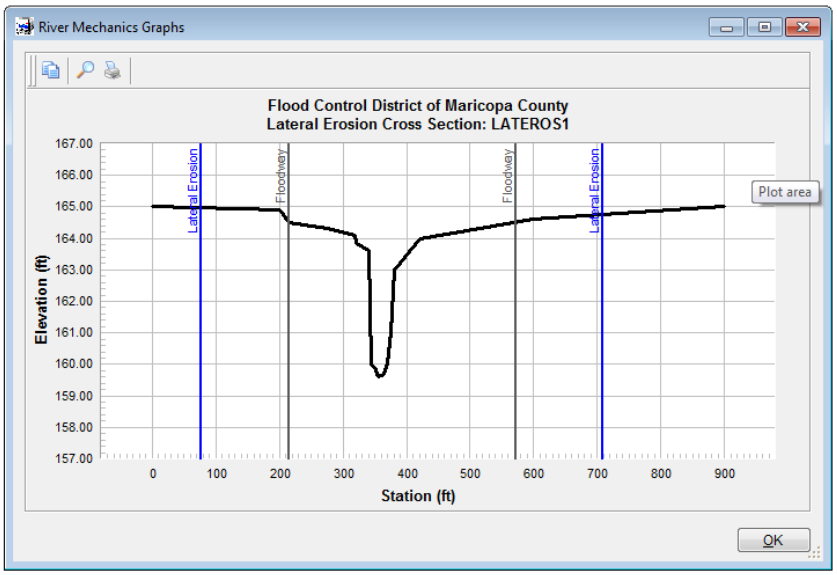
Note that by using the Cross Section Data, the **"Channel Depth, D (ft)"** textbox becomes "inactive" and a new value of the Channel Depth had replaced the manual data entered. This new value of the Channel Depth is the difference between the **FEMA Floodway Elevation** and the **Thalweg Elevation** (i.e., *164.50 -159.60 = 4.90ft*).

If the **Overbank** left and right values, **FEMA Floodway** left and right values, and, **Thalweg** values are not automatically populated, it may be required to re-define these values by going into the cross section data dialog box through the **"X Section Data"** button and select appropriate values for each of these parameters.

(n) To calculate the **Left Lateral Erosion Distance L_l (ft)**, and the **Right Lateral Erosion Distance, L_r (ft)**, click the ***Update*** button. The screen shot below shows the lateral erosion analysis results.



(o) To view the plot of the Lateral Erosion analysis results, click the **Graph** button.



This concludes the tutorial for the Lateral Erosion Analysis.

2.5 Sediment Yield for a Watershed

Estimate the sediment yield for a watershed.

1. Prepare Sediment and Relevant Data
   - A. Set up Sediment Yield Basic Data
   - B. Prepare ESRI Shape Files
   - C. Use GIS to Develop Land Use and Soils Data
   - D. Review Land Use and Soils Data
2. Calculate the Sediment Yield

2.5.1 Prepare Sediment and Relevant Data

A. Set up Sediment Yield Basic Data

(a) From the menu bar of main application window, click **River Mechanics ➔ Sediment Yield ➔ Model Sediment Yield** to open the **RIVER MECHANICS – SEDIMENT YIELD** window.

(b) Click **Add** button to activate the necessary data entry fields.

(c) Type "*DAM1"* into the **ID** textbox, a unique **ID** for the location on the water course.

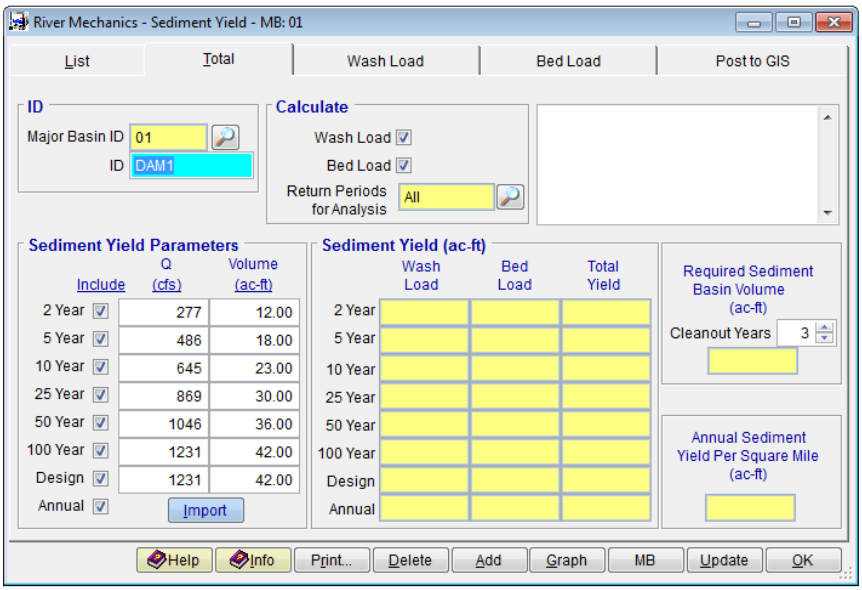
(d) Check the **Wash Load** and **Bed Load** checkboxes in the **Calculate** frame.

(e) Click the browse button beside the **Return Periods for Analysis** textbox in the **Calculate** frame to select "*All*" for the return periods.

(f) Check all the checkboxes in the **Sediment Yield Parameters** frame to activate all the discharges and volumes textboxes. Enter the following discharge and volume values for the sediment yield parameters

Return Period	**Q (cfs)**	**Volume (ac-ft)**
2 year	*277*	*12.00*
5 year	*486*	*18.00*
10 year	*645*	*23.00*
25 year	*869*	*30.00*
50 year	*1046*	*36.00*
100 year	*1231*	*42.00*
Design	*1231*	*42.00*

(g) Click the **Save** button to save the entered data. After the data entry, the window should look like the following figure.



(h) Click the **Wash Load** tab.

(i) Enter *"SED1"* into the **Sediment Area ID** textbox (**Sediment Area ID** is the unique ID for the drainage area that contributes sediment to the study location. This ID is used when land use and soil data are employed to compute the wash load).

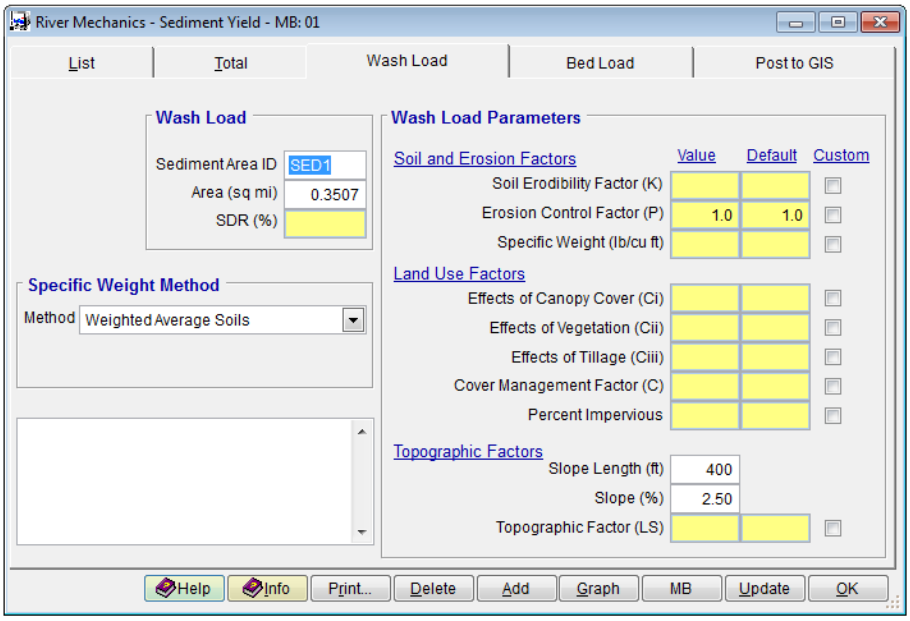
(j) Enter *"0.3507"* in the **Area (sq mi)** textbox.

(k) Select *"Weighted Average Soils"* as the **Specific Weight Method**.

(l) Enter *"400"* into the **Slope Length (ft)** text box in the **Wash Load Parameters** frame.

(m) Enter *"2.50"* into the **Slope (%)** textbox in the **Wash Load Parameters** frame.

(n) Click the **Save** button to save data entry. After the data entry, the **RIVER MECHANICS – SEDIMENT YIELD** form should look like the following figure.

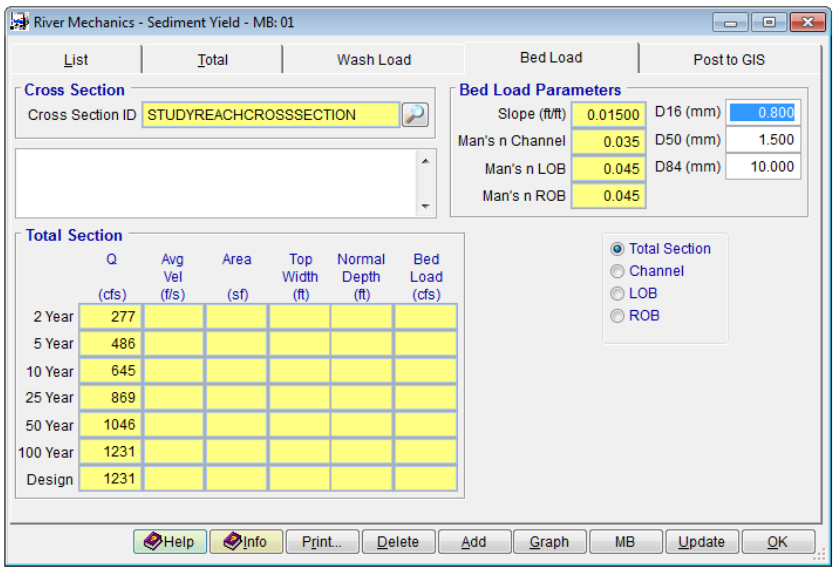


(o) Click the **Bed Load** tab and click browse button beside the **Cross Section ID** textbox in the **Cross Section** frame to select "*STUDYREACHCROSSSECTION*" as the cross section **ID**. Click **OK** to exit the **SELECT CROSS SECTION ID** form.

(p) On the **Bed Load Parameters** frame in the **Bed Load** tab, enter the following data:

- **D16 (mm):** *0.80*
- **D50 (mm):** *1.50*
- **D84 (mm):** *10.00*

(q) Click the **Save** button to save the data entered. The **RIVER MECHANICS – SEDIMENT YIELD form** should look like the following figure.



(r) Click **OK** to close the window.

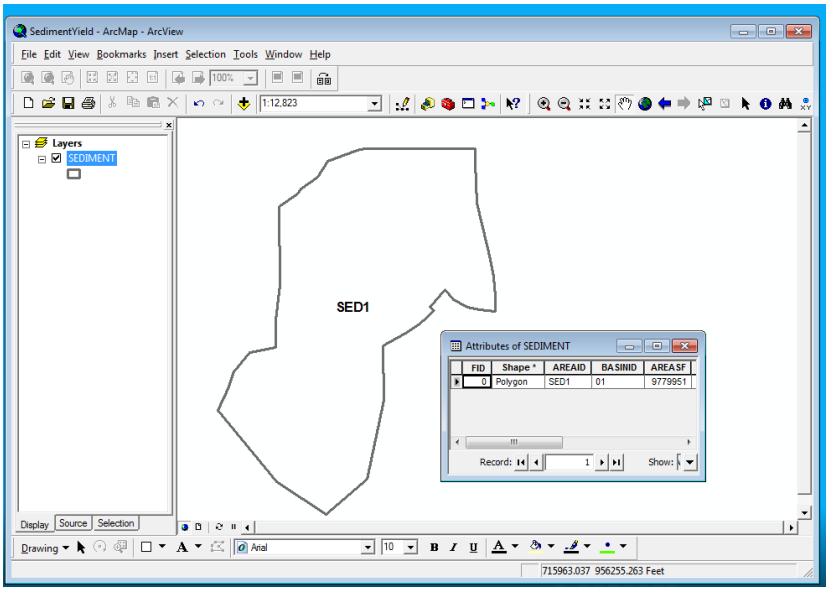
B. Prepare ESRI Shape Files

This step is for information purposes only. There is no action required for the tutorial user in this step. Several ESRI shape files must be prepared. They are: *Sediment, Land Use* and *Soils*. As part of the shape files, the table structures must include specific fields. For the purposes of this tutorial, all these shape files have already been prepared. This tutorial does not cover the creation of the shape files. For tutorials on how to create ESRI shape files, please refer to "**HOW TO PREPARE ESRI SHAPE FILES FOR DDMSW**" document that can be downloaded from http://www.fcd.maricopa.gov/264/How-to-Prepare-ESRI-Shape-Files. The following section describes the general requirement for the required shape file table. Specific file names for the shape files are not necessary, however, for the purpose of this tutorial the following map files will be used. However field names inside the tables must be created and formatted correctly. The field names and data types of required fields are provided in the following section.

Sediment

The Sediment map (*Sediment.shp*) will contain a single polygon with the following fields:

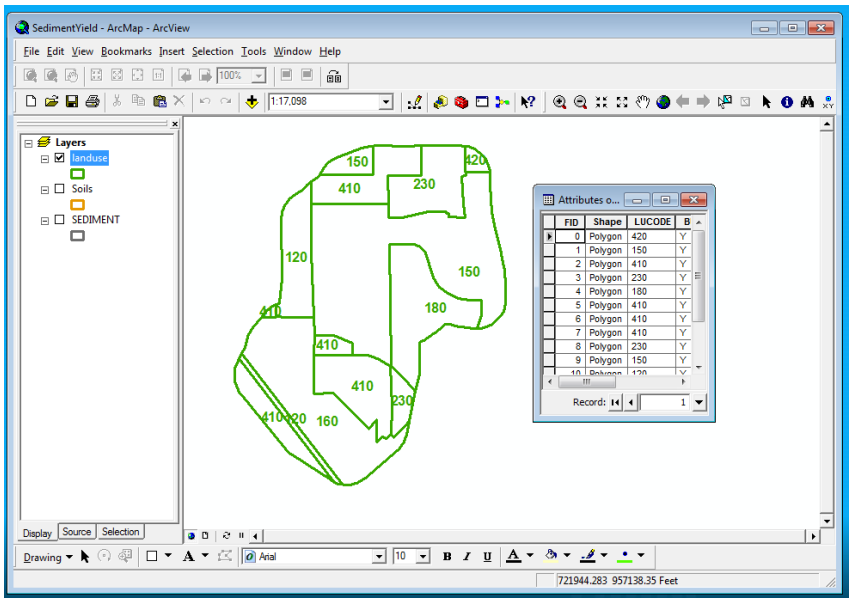
- **AREAID** Character 6 Enter unique **Sediment ID**
- **BASINID** Character 2 Enter **Major Basin ID**
- **AREASF** Numeric 12.0 Data entered into this field will be overwritten internally within **DDMSW**. This field contains the Sediment watershed area in square feet. The data for this field is calculated automatically when the **Update** button is clicked on the **UPDATE FROM GIS** form in **DDMSW**.



Land Use

Land Use data can often be obtained from the jurisdictional agency. The data may have to be modified to be consistent with DDMSW requirements. The Land Use map (*Landuse.shp*) will contain polygons for land use data. There can be more than one polygon with the same land use ID. It is vitally necessary that the land use coverage extends beyond the extent of Sediment watershed polygon. The required fields include:

- **LUCODE** Character 15 **LUCODE** values should be consistent with the values in the **DDMSW** land use defaults table.

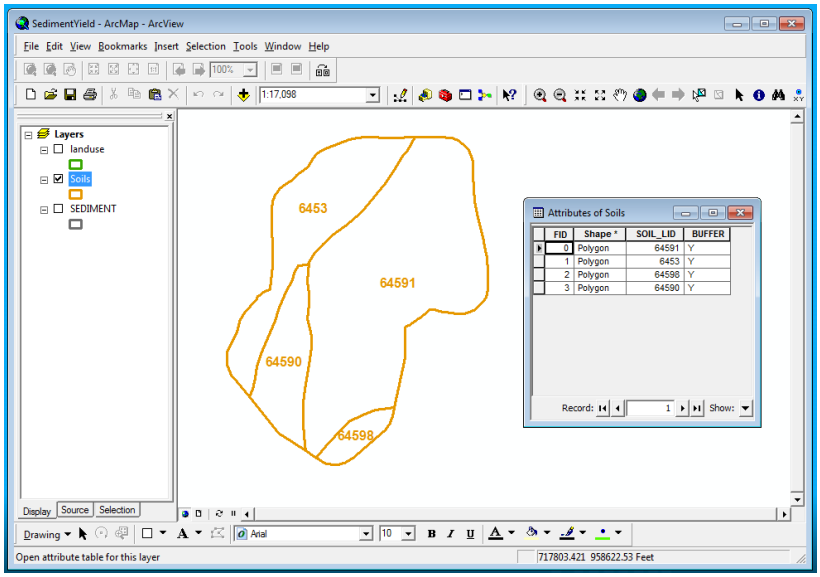


Soils

Soils data can often be obtained from the FCDMC. The data should be reviewed to make sure it is consistent with DDMSW requirements. The Soils map will contain polygons for

soils data. A **GIS** map for soils data can be obtained from the Flood Control District. There can be more than one polygon with the same Soil ID. It is vitally necessary that the soils coverage extends beyond the extent of the Sediment watershed polygon. The required fields include:

- **SOIL_LID** Numeric 15 **SOIL_LID** values should be consistent with the values in the **DDMSW** soil defaults table.



C. Use GIS to Develop Land Use and Soils Data

(a) From the menu bar of the main application window, click **River Mechanics** ➔ **Sediment Yield**➔ **Update from GIS** to open the **UPDATE FROM GIS** form. The form below shows the items to be selected.

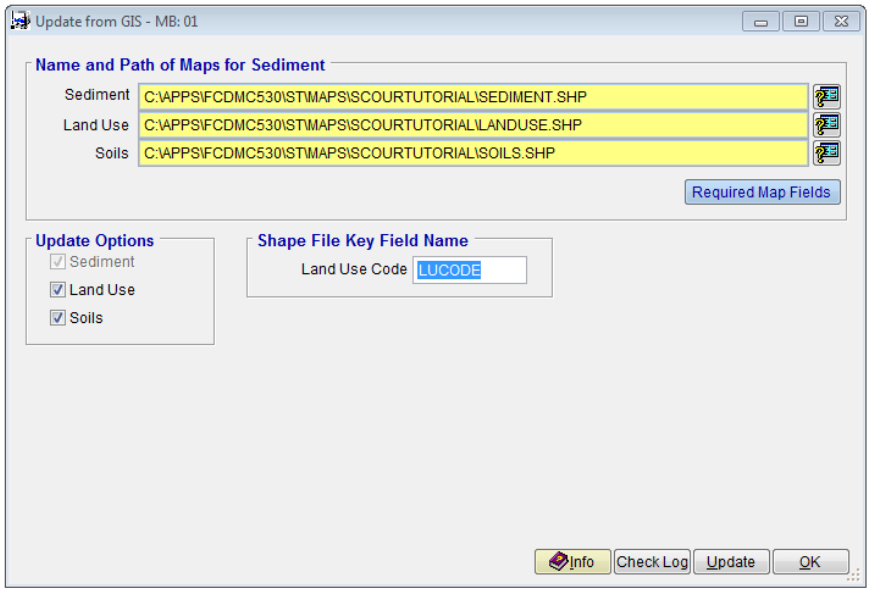
(b) Make sure to check Land Use and Soils in the **Update Options** data frame.

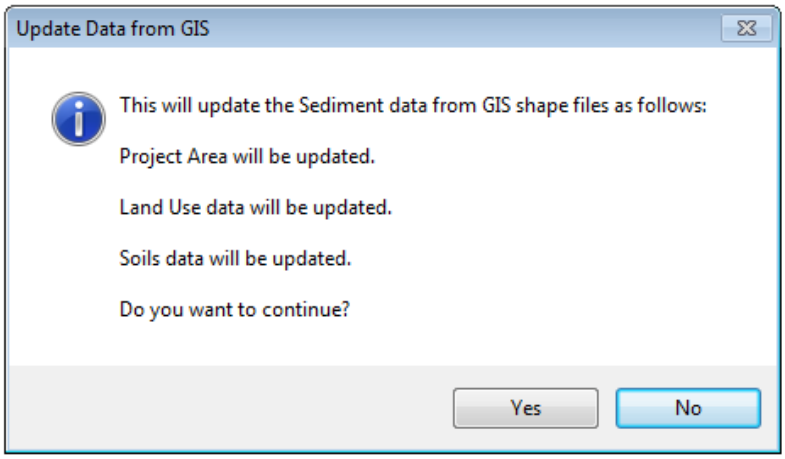
(c) Migrate to the location of the Sediment, Land Use and Soils shapefiles to select the Sediment, Land Use and Soils shapefiles respectively. The actual path may be different to what is shown on the following form.

(d) Enter *"LUCODE"* as the **Land Use Code** in the **Shape File Key Field Name**

(e) Click the **Save** button to save the entered data.

(f) Click **Update** to develop the Land Use and Soils data.





(g) Click **Yes** to continue.

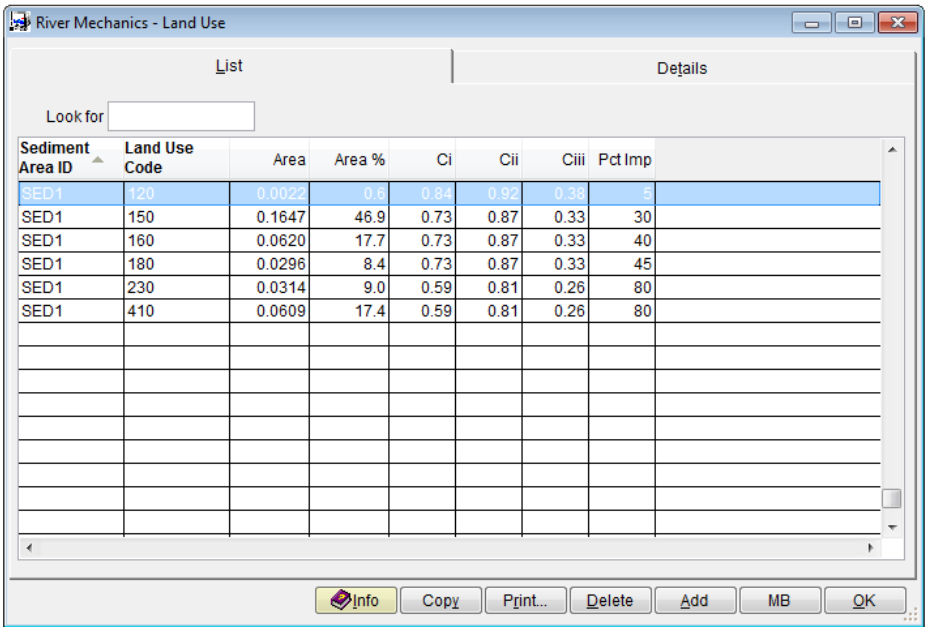
(h) Click **OK** to close the **UPDATE FROM GIS** form.

D. Review Land Use and Soils Data

The Land Use and Soils data have been developed from **GIS**. It is necessary to review the data to make sure that the information is correct.

Land Use

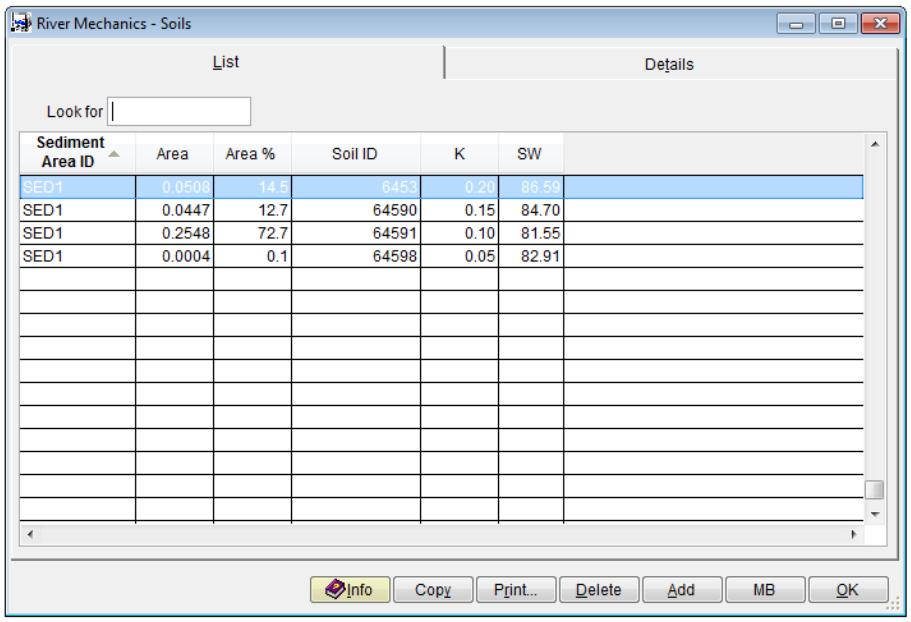
(a) From the menu bar of the main application window, click **River Mechanics** ➔ **Sediment Yield**➔ **Land Use** to open the **RIVER MECHANICS - LAND USE** form. The form below shows the extent of the data for the **Sediment Area** *"SED1"*.



(b) Click the **OK** button to close the **RIVER MECHANICS - LAND USE** form.

Soils

(c) From the menu bar of the main application window, click **River Mechanics** ➔ **Sediment Yield**➔ **Soils** to open the **RIVER MECHANICS - SOILS** form. The form below shows the extent of the data for the **Sediment Area** *"SED1"*.

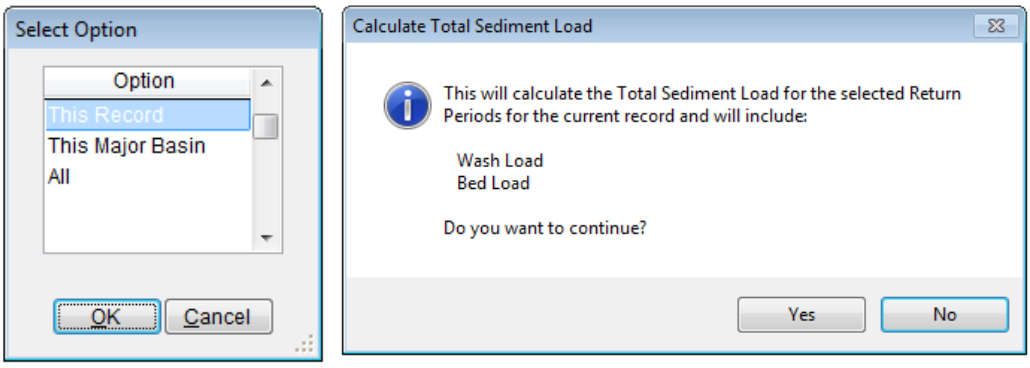


(d) Click the **OK** button to close the **RIVER MECHANICS - SOILS** form.

2.5.2 Calculate the Sediment Yield

Open the **RIVER MECHANICS – SEDIMENT YIELD** form from the menu bar (**River Mechanics ➔ Sediment Yield ➔Model Sediment Yield** and click the **Total** tab.

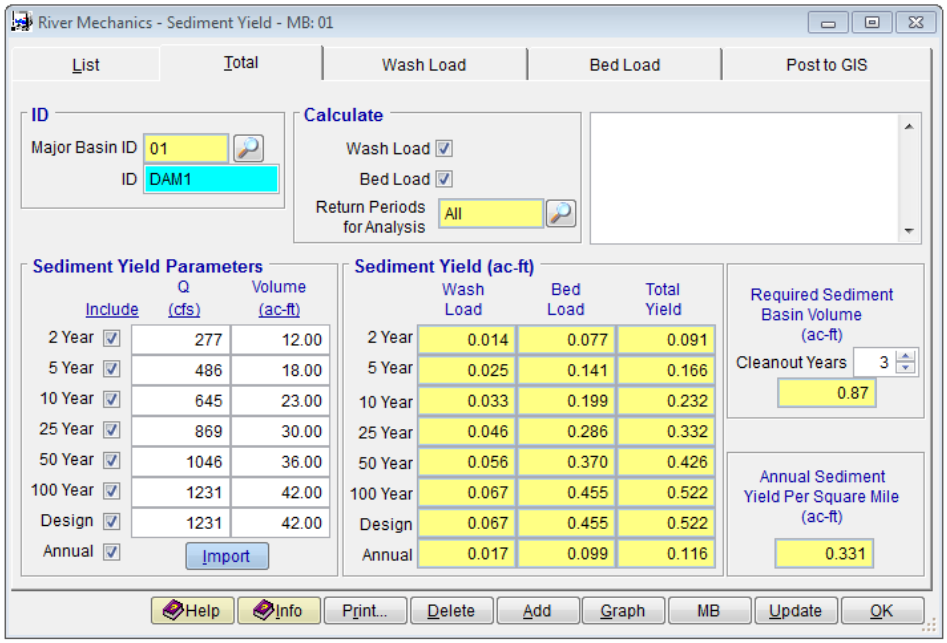
(a) Click the **Update** button on the **RIVER MECHANICS – SEDIMENT YIELD** form to compute the sediment yield. A new window **SELECT OPTION** opens, select "*This Record*", and click **OK** to close it.



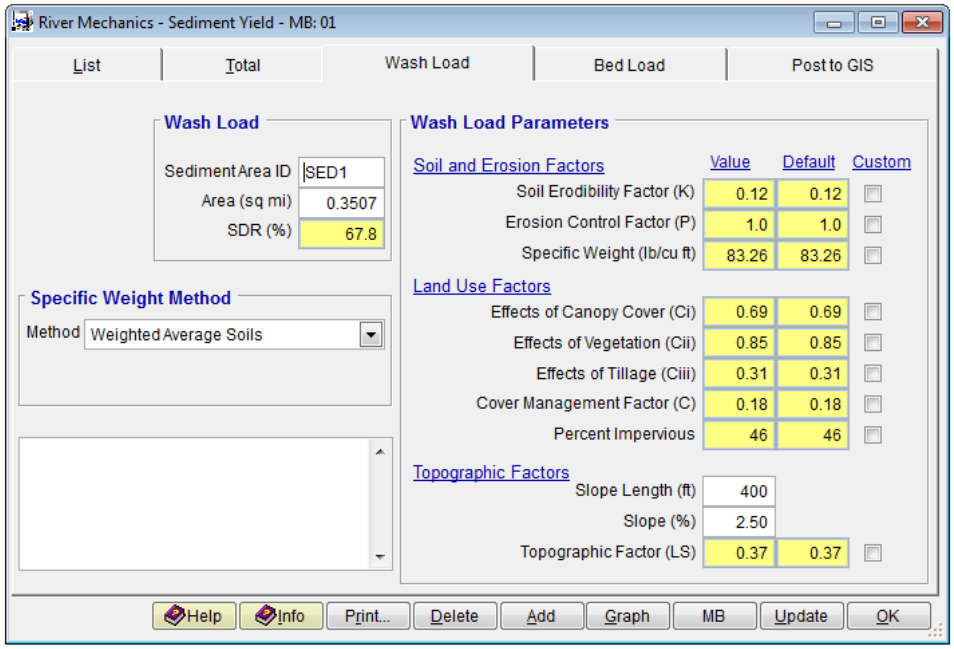
(b) On the **CALCULATE TOTAL SEDIMENT LOAD** dialog box, click **Yes** to continue.

The following three figures show the results in the **Total**, **Wash Load** and **Bed Load**.

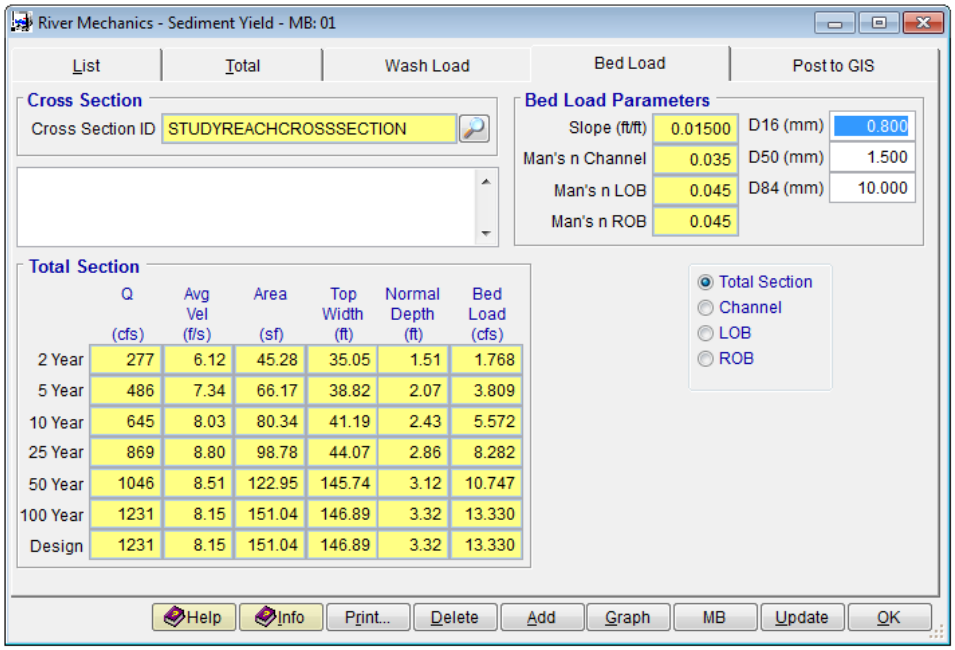
Total Sediment Load:



Wash Load:



Bed Load:

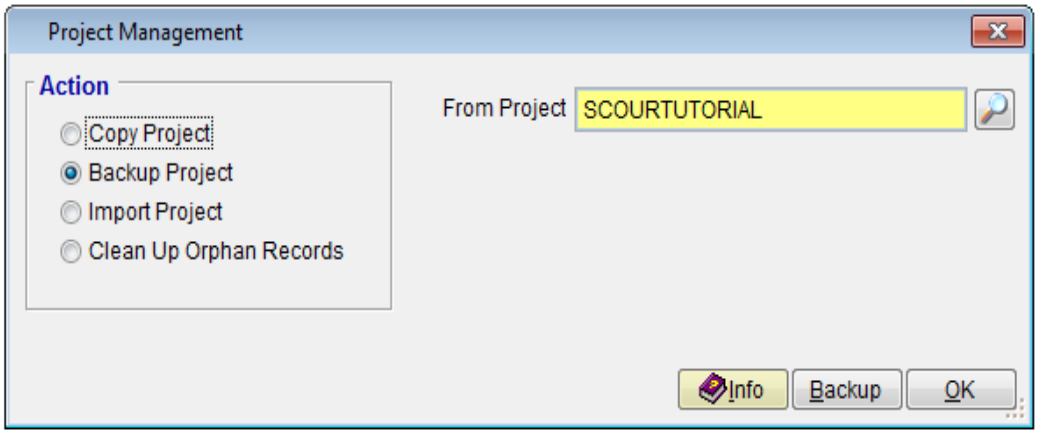


(c) Click the **OK** button to close the **SEDIMENT YIELD** form.

2.6 Backup Project

To create a backup file for the project, perform the following steps:

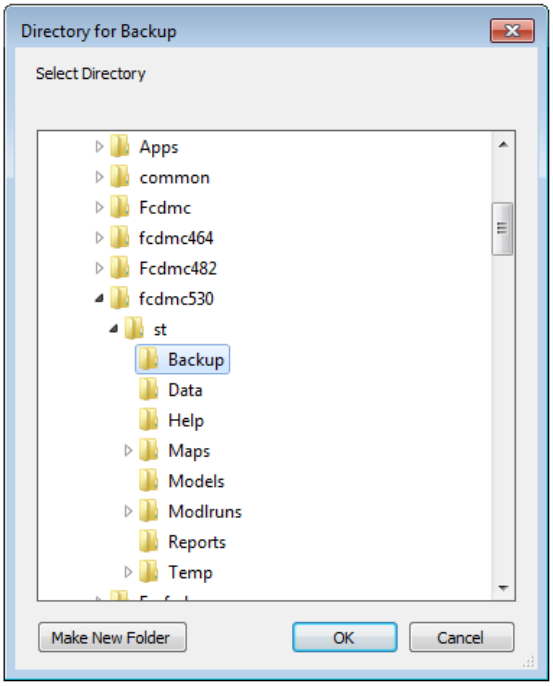
(a) From the menu bar of the main application window, click **File** ➔ **Project Management** as shown in the following figure and the **PROJECT MANAGEMENT** window opens.



(b) Check the **Backup Project** radio button.

(c) Click the **Backup** button.

(d) Select a folder where to save the backup project file(s) (defaults to **Backup** sub directory).



(e) Click **OK**

This concludes all the tutorials.